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wood shall bolt over it, and be of as much substance as the knee itself: therefore the knee must consequently be placed its whole thickness below the cutting down line representing the upper part of the dead wood.

The sheer draught, the body, and half-breadth plans are now finished, from whence the ship may be laid down in the mould loft, and also the whole frame erected. As, however, the use of the diagonal lines in the body plan has not been sufficiently explained, it is therefore thought proper to subjoin the following illustration of them.

45 Nature and use of diagonal lines.

The diagonal lines in the body plan are mentioned in the tables of dimensions merely for the purpose of forming the body therefrom; but after the body is formed, they are of very principal use, as at their stations the ribbands and harpins which keep the body of the ship together while in her frames are all described, and the heads of the different timbers in the frame likewise determined.

The lowermost diagonal, or n° 1. which is named the *lower firmark*, at which place the bevellings are taken for the hollow of the floors; its situation is generally in the middle between the keel and the floor firmark.

Second diagonal is placed in the midships, about 18 inches below the floor head, and is the station where the floor ribband is placed in midships, and likewise the floor harpin forward; there is also a bevelling taken at this diagonal all the way fore and aft, from which it is termed the *floor firmark*.

Third diagonal, terminates the length of the floors, and is therefore called the *floor head*. There are likewise bevellings taken at this diagonal as far forward and aft as the floor extends. The placing of this diagonal is of the utmost consequence to the strength of the ship, it being so near to that part of the bulge which takes the ground, and of consequence is always liable to the greatest strain; it should therefore be placed as much above the bearing of the body in midships as could be conveniently allowed by conversion of the timber; but afore and abaft it is not of so much consequence.

Fourth diagonal is placed in the middle between the floor head and the fifth diagonal, at which place a ribband and harpin are stationed for the security of the first or lower futtock, from whence it is named the *first futtock firmark*. There are also bevellings taken at this diagonal all afore and aft, which being part of the body where the timbers most vary, occasions them to be the greatest bevellings in the whole body.

Fifth diagonal terminates the heads of the first futtocks, and is therefore called the *first futtock head*. It should be placed at a convenient distance above the floor head, in order to give a sufficient scarf to the lower part of the second futtocks. There are likewise bevellings for the timbers taken at this diagonal, all fore and aft.

Sixth diagonal should be placed in the middle between the first futtock head and the seventh diagonal; at which place the ribband and harpin are stationed for the support of the second futtocks. Bevellings are taken at this diagonal all fore and aft. It is named the *second futtock firmark*.

Seventh diagonal terminates the second futtock heads from the fore to the aftermost floors, and afore and abaft them it terminates the double futtock heads in the fore and aft cant bodies. It should be placed in midships, as much above the first futtock head as the first futtock is above the floor head: by which it gives the same scarf to the lower part of the third futtock as the first futtock does to the second. There are bevellings taken all fore and aft at this diagonal. It is named the *second futtock head*.

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Eighth diagonal is the station for the ribband and harpin which supports the third futtocks, and is therefore placed between the second futtock head and ninth diagonal. It is also a bevelling place, and is named the *third futtock firmark*.

Ninth and last diagonal is placed the same distance above the second futtock head as that is above the first, and terminates all the heads of the third futtocks which are in the frames, as they come between the ports; but such as are between the frames, and come under the lower deck ports, must run up to the under part of the ports, as no short timbers should by any means be admitted under the ports, which require the greatest possible strength. This diagonal is likewise a bevelling place for the heads of the third futtocks, and is therefore called the *third futtock head*.

The fourth futtock heads are terminated by the under part of the upper deck ports all fore and aft, and a ribband is placed fore and aft at the height of the upper breadth line, another between the lower and upper deck ports, and one at the top-timber line; which, with the ribbands and harpins before-mentioned, keep the whole body of the ship together, and likewise in its proper form and shape.

It must be observed, that the diagonal lines laid down in the dimensions will not correspond to what has been said above upon diagonals, as they were drawn discretionally upon the body for the purpose of giving the true dimensions of it. Therefore, when the body is drawn in fair, the first diagonals (which should only be in pencil) are to be rubbed out, and the proper diagonals drawn with red ink, strictly adhering to what has been said above.

SECT. III. *Of the Inboard Works of the Ship described in the preceding Section.*

DRAUGHTS of the outboard works being now constructed, in which every part is described that is necessary to enable the artist to put the ship in her frames, we must now proceed to form another draught of the cavity of the ship or inboard works, which must be so contrived that every thing within the ship may be arranged in the most commodious manner and to the best advantage.

It is usual to draw the inboard works in the sheer-draught; but as this generally occasions much confusion, it is therefore the best and easiest method to appropriate a draught to this particular purpose. *Ship-Builder's Repository.*

Take from the sheer draught the stem, stern-post, counter timbers, and keel, and describe them on another paper; draw in also the cutting down, kelson, apron, transoms, fashion-pieces, and decks, and the upper line of the sheer all fore and aft, also the timbers and ports.

The beams come first under consideration, and should be so disposed as to come one under and one between each port, or as near as can be to answer other works of the ship; but where it happens that a beam cannot possibly be placed under the port, then a beam arm

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ſhould be introduced to make good the deficiency. Every beam, and alſo the beam arms, ſhould be kneed at each end with one lodging and one hanging knee; and in thoſe parts of the ſhip which require the knees to be very acute, ſuch as the after beams of the gun-deck, and in ſome ſhips, whoſe bodies are very ſharp, the foremoſt beams of the gun-deck, there ſhould be knees of iron. Care ſhould be taken always to let the upper ſide of the knees be below the ſurface of the beams in large ſhips one inch and a half, and in ſmall ſhips an inch, by which means the air will have a free paſſage between the knees and under part of the deck.

In the converſion of the beams the ſide next the lodging knee ſhould be left as broad at the end of the beam as can poſſibly be allowed by the timber, the beam retaining its proper ſcantling at the end of the lodging knee: by ſo doing the lodging knees will be more without a ſquare, which conſequently makes them the more eaſy to be provided.

In ſhips where the beams can be got in one piece, they ſhould be ſo diſpoſed as to have every other one with the butt end the ſame way; for this reaſon, that the butts will decay before the tops. In large ſhips the beams are made in two or three pieces, and are therefore allowed to be ſtronger than thoſe that are in one piece. The beams in two pieces may have the ſcarf one-third of the length, and thoſe in three pieces ſhould have the middle piece half the length of the whole beam. The cuſtomary way of putting them together is to table them; and the length of the tablings ſhould be one-half more than the depth of the beam. It is very common to divide the tablings in the middle of the beam, and that part which is taken out at the upper ſide to be left at the lower ſide, and then kerſey or flannel is put into the ſcarf: but in this caſe the water is liable to lie in the ſcarf, and muſt be the means of rotting the beams. If, however, the beams were tabled together in dovetails, and taken through from ſide to ſide, putting tar only between them, which hardens the wood; then the water occaſioned by the leaking of the decks would have a free paſſage, and the beam would dry again; and this method would not be found inferior in point of ſtrength to the other. The length of the fore and aft arm of the lodging knee ſhould extend to the ſide of the hanging knee next to it; but there is no neceſſity for that arm to be longer than the other. In faſtening the knees, care ſhould be taken to let one bolt paſs exactly through the middle of the throat, one foot ſix inches from each end, and the reſt divided equally between; obſerving always to have the holes bored ſquare from the knee. The bolts for the thwartſhip arms of both hanging and lodging knees may go through the arms of each knee, and drive every one the other way.

In order to draw the beams in the draught, take the moulding of the lower deck beams, and ſet it off below the line repreſenting the deck at the ſide, and draw a line in pencil parallel thereto, which will repreſent the under ſide of the beams. In like manner repreſent the under ſide of the beams for the upper deck, quarter deck, forecaſtle, and roundhouſe. Then take the ſiding of the lower deck beams, and place one under and one between each port, all fore and aft, drawing them in pencil. Determine the dimenſions of the well fore and aft, which is ten feet, and ſet it off abaft the beam under the eighth port, placing the beam under the ninth port at that diſtance: thoſe two beams may then be drawn in ink, and will terminate the extent of the well the fore and aft way; and as a beam cannot go acroſs the ſhip at that place upon account of its being the well and maſt room, there muſt therefore be a beam arm between theſe two beams. Application of the foregoing Rules to the Conſtruction of Ships.

The main hatchway ſhould then be determined, letting the beam that forms the fore part of the well form the aft part of it, and the beam under the next part may form the fore ſide of it, which beam may alſo be now drawn in ink: there ſhould alſo be another beam arm introduced in the wake of the main hatchway.

The fore hatchway may be next determined; the fore ſide of which ſhould range well up and down with the after end of the forecaſtle, and it may be fore and aft about four-ſevenths of the main hatchway. At the foreſide of the fore hatchway there muſt be a ladderway down to the orlop, which may be as much fore and aft as the beams will allow. The reſt of the beams afore the fore hatchway may remain as firſt placed, there being nothing in the way to alter the ſhip. Then determine on the after hatchway, the foreſide of which comes to the aft ſide of the mainmaſt room.

There ſhould alſo be a hatchway, the foreſide of which may be formed by the aft ſide of the beam under the twelfth port; which is for the convenieney of the ſpirit and fiſh rooms: and there ſhould be a ladderway abaft it to lead down to the cockpit. There may be alſo another hatchway, the foreſide of it to be formed by the aft ſide of the beam under the eleventh port. The ſize of the ladder and hatchways muſt be governed by the beams, as when there is a good ſhift of beams they ſhould not be altered for ladder and hatchways, unleſs it is the three principal hatchways, which muſt always be of a proper ſize, according to the ſize of the ſhip.

The after capſtan muſt be placed between the two hatchways laſt deſcribed, and the beams abaft may ſtand as they are already ſhifted, obſerving only the mizenmaſt. There ſhould be a ſmall ſcuttle placed afore the ſecond beam from aft, for the convenience of the bread room: it muſt be on one of the middle lines, as there is a carling at the middle under the four or five after beams to receive the pillars for the ſupport thereof.

The bits may be placed, letting the foreſide of the after ones come againſt the aft ſide of the beam abaft the third port, and the foreſide of the foremoſt ones againſt the next beam but one forward; then at the foreſide of each bit there ſhould be drawn a ſmall ſcuttle for the conveniency of handing up the powder from the magazine. The breaſt hook ſhould alſo be drawn, which may be three feet the moulding away, and ſided nine-tenths of the beams of the lower deck.

The gun-deck, beams, knees, &c. being deſcribed; in which, as well as all the decks having ports, the ſame precautions are to be uſed as in the gun-deck; and obſerving to keep the beams upon one deck as nearly as poſſible over the beams of the other, for the conveniency of pillaring, as they will then ſupport each other.

The hatchways are to be placed exactly over thoſe on

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on the lower deck, each over each; and therefore, where there is a beam arm in the lower deck there muſt alſo be one above it in the upper deck, and the ſame in the middle deck in three-deck ſhips. It commonly happens in ſhips of the line that there cannot be a whole beam between the deck breaſt hook and the beam that ſupports the ſtep of the bowſprit, becauſe the bowſprit paſſes through that place: in this caſe, there muſt be a beam arm placed, letting the end come equally between the beam and the breaſt hook: but in ſhips that the bowſprit will allow of a whole beam, then the ports and the reſt of the beams muſt be conſulted in order to ſpace it; and when it ſo happens that the foremaſt comes in the wake of a port, then a beam arm muſt be neceſſarily introduced.

Having placed the beams according to the diſpoſition of the other beams below, the ladder-ways ſhould be contrived: there ſhould be one next abaft the fore hatchway, which is a ſingle ladder-way; and one next afore the main hatch, which is a double ladder-way; the ladders ſtanding the fore and aft way. There ſhould alſo be another next abaft the after hatch, and one over the cockpit correſponding with that on the lower deck.

The capſtans are next to be conſidered; the after one is already placed on the lower deck, the barrel of which muſt paſs through the upper deck to receive the whelps and drumhead there, it being a double capſtan. In ſhips having three decks, the upper part of each capſtan is in the middle deck; but in ſhips with one deck there is only this one capſtan, the upper part of which is placed on the quarter deck. The foremoſt capſtan ſhould be placed in the moſt convenient ſpot, to admit of its being lowered down to the orlop out of the way of the long boat: it may therefore be placed between the main and fore hatchways; the beam under the ſixth port of the lower deck may form the aft ſide of its room, and the beams on each ſide of it ſhould be placed exactly over or under the beams on the other decks, and they ſhould be at a diſtance from each other ſufficient to let the drumheads paſs between them. The centre of the capſtan ſhould then be placed in the middle between the beams which compoſe its room; and the partners ſhould be fitted in ſuch a manner as to ſhift occaſionally when wanted, which is by letting them be in two pieces fitted together. The partners on the lower deck, wherein the capſtan ſteps, muſt be ſupported by a pillar on the orlop deck, the lower part of which may be fitted in an oak chock; ſo that when the pillar is taken away, and the capſtan lowered down, that chock ſerves as a ſtep for the capſtan. Thoſe two beams on the orlop, by having the pillar and chock upon them, have therefore the whole weight of the capſtan preſſing downwards: for the ſupport of them, there ſhould be a carling placed underneath the fore and aft way, with three pillars, one under each beam, and one between; all of them being ſtept in the kelſon, by which the orlop deck will be well ſupported in the wake of the capſtan, and the other decks will feel no ſtrain from it.

The fire hearth is next to be diſpoſed; which is placed differently according to the ſize of the ſhip. In three-deckers it is found moſt convenient to place it on the middle deck; whence there is much more room under the forecaſtle than there would have been had it been placed there. In all two-deck ſhips it is placed under the forecaſtle, becauſe on the deck underneath the bits are in the way. It is alſo under the forecaſtle in one-deck ſhips, though confined between the bits: in this caſe it ſhould be kept as near as poſſible to the after bits, that there may be more room between it and the foremoſt bits to make a good galley.

The poſitions of the main-topſail-ſheet bits are next to be determined; the foremoſt of which muſt be ſo placed as to let its foreſide come againſt the aft ſide of the beam abaft the main hatchway, and to paſs down to the lower deck, and there ſtep in the beams: admitting it to be a ſtraight piece, it would come at the aft ſide of the lower deck beam the ſame as it does at the upper deck beam, in conſequence of thoſe two beams ranging well up and down with each other: it muſt therefore have a caſt under the upper deck beam, by which the lower part may be brought forward ſufficient to ſtop in the lower deck beam. The aftermoſt muſt be placed againſt the foreſide of the beam abaft the maſt, and ſtep on the beam below; but there is no neceſſity to provide a crooked piece as before, for the beam of the upper deck may be moved a little farther aft, till it admit of the bit ſtopping on the lower deck beam, unleſs the beam comes under a port, as in that caſe it muſt not by any means be moved. The croſs pieces to the bits ſhould be on the foreſide, and in height from the upper deck about one-third of the height between it and the quarter deck. With regard to the heads of the bits, the length of the ſhip's waſte ſhould be conſidered; and if there is length enough from the forecaſtle to the foremoſt bits to admit of the ſpare geer being ſtowed thereon without reaching farther aft, the quarter deck may then run ſo far forward that the head of the foremoſt bits ſhall tenon in the foremoſt beam; this gives the mainmaſt another deck, and admits of the quarter deck being all that the longer: but if there is not the room before mentioned, then the quarter deck muſt run no further forward than the after bits, which will then tenon in the foremoſt beam; and the foremoſt bits muſt have a croſs piece let on their heads, which is termed a *horſe*, and will be for the purpoſe of receiving the ends of the ſpare geer.

The length of the quarter deck being now determined, the beams are then to be placed. For this purpoſe the ſeveral contrivances in the quarter deck muſt be previouſly conſulted. It is neceſſary to obſerve, that there are neither carlings nor lodges, the carlings of the hatches excepted, in the quarter deck, round-houſe, and forecaſtle; as they would weaken inſtead of ſtrengthening the beams, which ſhould be as ſmall as the ſize of the ſhip will permit, in order that the upper works may be as light as poſſible. Hence, as there are to be neither carlings nor lodges, the deck will require a greater number of beams, and a good round up, as on the contrary the deck would be apt to bend with its own weight. The moſt approved rule is therefore to have double the number of beams in the quarter deck as there are in a ſpace of the ſame length in the upper deck.

Then proceed to ſhift the beams to the beſt advantage, conſulting the hatchways, ladder-ways, maſts, bits, wheel, &c. With reſpect to the ladder-ways on the quarter decks of all ſhips, there ſhould be one near the fore part of the great cabin for the officers, and an-

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other near the foremoſt end of the quarter deck, conſiſting of double ladders for the conveyance of the men up from the other decks in caſes of emergency; and likewiſe one on each ſide of the fore part of the quarter deck from the gangway: and in every ſhip of the line all the beams from the foremoſt ladder-way to the after one ſhould be open with gratings, both for the admiſſion of air, and for the greater expedition of conveying different articles in the time of action.

Two ſcuttles are to be diſpoſed one on each ſide of the mainmaſt, if it happens to come through the quarter deck, for the top tackles to paſs through, to hook to the eye bolts drove in the upper deck for that purpoſe.

The ſteering wheel ſhould be placed under the forepart of the roundhouſe, and the two beams of the quarter deck, which come under it, ſhould be placed conformable to the two uprights, ſo that they may tenon in them. The quarter deck beams ſhould be kneed at each end with one hanging and one lodging knee; which adds greatly to the ſtrength of the ſide. The hanging knees which come in the great cabin may be of iron; their vertical arms to be two-thirds of the length of that of wood, and to reach the ſpirketing. It ſhould be obſerved, that the beam abaft, which comes under the ſcreen bulkhead, ſhould round aft agreeable to the round of the bulkhead, for the ſupport of the ſame.

The forecaſtle beams ſhould be placed according as the works of the deck will admit. The hatchways are therefore to be conſidered firſt. There ſhould be one for the funnel of the fire hearth to paſs through, and one for the copper to admit of vent for the ſteam; and alſo one or two over the galley as the forecaſtle will admit of. The fore-topſail-ſheet bits ſhould be ſo diſpoſed as to come one pair on the fore and one on the aft ſide of the maſt, to let into the ſide of the forecaſtle beams, and ſtep on the upper deck beams below: there ſhould alſo be a ladder-way at the fore part of the forecaſtle for the conveniency of the fore part of the ſhip.

The beams may now be placed agreeable thereto, their number being four more than there are in a ſpace in the upper deck equal in length to the forecaſtle; and where there happens to be a wide opening between the beams, as in the caſe of a hatchway, maſt room, &c. then half a beam of fir may be introduced to make good the deficiency. The foremoſt beam ſhould be of a breadth ſufficient to take the aft ſide of the inboard arms of the catheads, as they are ſecured upon this beam by being bolted thereto. Every beam of the forecaſtle ſhould be kneed at each end with one hanging and one lodging knee: the vertical arms of the hanging knees ſhould reach the ſpirketing, and the knees well bolted and carefully clenched.

Proceed to the roundhouſe; the ſame things being obſerved with reſpect to the beams as in the quarter deck: for as the roundhouſe beams are ſided very ſmall, it hence follows that they muſt be near to each other. Let therefore the number of beams on the roundhouſe be four more than in the ſame length of the quarter deck; every other beam being of fir for lightneſs, and every oak beam may be kneed at each end with one hanging and one lodging knee; the hanging knees abaft may be of iron, their vertical arms to be in length two thirds of thoſe of wood. The roundhouſe ſhould always have a great round up, both for ſtrength and conveniency. There muſt be on the roundhouſe a ſmall pair of knee-bits on each ſide of the mizenmaſt, turned round and ſcarfed over each other, and bolted through the maſt carlings. There muſt alſo be a companion on the roundhouſe placed over the middle of the coach, in order to give light thereto.

With regard to placing the roundhouſe beams, the uprights of the ſteering wheel and the mizenmaſt are to be obſerved; as when the beams which interfere with thoſe parts are properly ſpaced, the reſt may be diſpoſed of at diſcretion, or at an equal diſtance from each other, and letting the beam over the ſcreen bulkhead have a proper round aft, agreeable to the quarter deck beam underneath.

The upper parts of the inboard works being now deſcribed, proceed next to the lower parts, or to thoſe which come below the lower deck. Draw in the orlop, by taking the heights afore, at midſhips, and abaft, between that and the gun-deck, from the dimenſions, and a curve deſcribed through theſe points will repreſent the upper part of the deck. Set off the thickneſs of the plank below, and the under ſide of the plank will be repreſented. As this deck does not run quite forward and aft as the other decks, the length of it muſt be therefore determined; for this purpoſe let the after beam be placed at a ſufficient diſtance from aft to admit of the bread rooms being of a proper ſize for the ſhip, which will be under that beam of the gun deck that comes at the ſecond part from aft. The after beam being drawn in, proceed to ſpace the other beams, placing them exactly under thoſe of the gun-deck; and that which comes under the foremoſt beam of the gun-deck may terminate the fore part of the orlop. Draw the limber ſtrake, by ſetting off its thickneſs above the cutting down line, and a line drawn parallel thereto will repreſent the limber ſtrake. That part of the orlop which is over the after magazine, ſpirit room, and fiſh room, and alſo that which is over the fore magazine, is laid with thicker planks than the reſt of the deck; which is for the better ſecurity of thoſe places, the planks being laid over the beams; but in the midſhips, from the fore part of the ſpirit room to the aft part of the fore magazine, the beams are laid level with the ſurface of the deck, and the planks are rabbeted in from one beam to the other.

In order to repreſent the orlop as juſt deſcribed, the dimenſions of the different apartments above mentioned muſt be determined: Let the aft ſide of the after beam be the aft ſide of the after magazine, and from thence draw the bulkhead down to the limber ſtrake; and the foreſide of the third beam may be the foreſide of the after magazine, drawing that bulkhead likewiſe, which will alſo form the aft ſide of the fiſh room; the foreſide of the fiſh room may be drawn from the aft ſide of the fifth beam, which will alſo repreſent the aft ſide of the ſpirit room; then the foreſide of the ſpirit room may be drawn from the foreſide of the ſixth beam. Hence from the foreſide of the ſixth beam quite aft the deck will be repreſented by the two lines already drawn, and the upper ſide of the beams will be repreſented by the lower line.

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Proceed next to the forepart of the orlop, letting the fore-

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foreſide of the after bits be the aft part of the foremoſt magazine, drawing the bulkhead thereof, which will come to the aft ſide of the ſixth beam; therefore, from the ſixth beam to the foremoſt end of the orlop, the plank and beams will be repreſented juſt in the ſame manner as before mentioned for the after part of the orlop: then the midſhip part of the deck will be repreſented by letting the upper line be the upper ſide of the plank, and likewiſe the upper ſide of the beams; and the lower line will repreſent the lower edge of the plank, only drawing it from beam to beam, and obſerving not to let it paſs through them.

The hatchways, &c. may now be repreſented on the orlop, letting the main, fore, and after hatchway, be exactly under thoſe of the gun-deck: there muſt be one over the fiſh room, and one over the ſpirit room. There muſt be two ſcuttles over the after magazine for the paſſage to the magazine and light room. There ſhould alſo be one afore the fourth beam from forward for the paſſage to the fore magazine, and one abaft the ſecond beam for the paſſage to the light room.

The bulkheads for the fore and after parts of the well may be drawn from the lower deck beams to the orlop, and from thence to the limber ſtrake in the hold. The ſhot lockers may alſo be repreſented, having one afore and one abaft the well: there ſhould alſo be one abaft the foremoſt magazine, the ends of which may be formed by the after bits. The ſteps of the maſts may be drawn in by continuing their centres down to the limber ſtrake; and likewiſe two crutches abaft the mizen ſtep divided equally between that and the after part of the cutting down: the breaſt hooks may alſo be drawn letting them be five in number below the lower deck hook, and all equally divided between that and the fore ſtep. Hence every part of the inboard is decribed as far as neceſſary.

Chap. V. *Of the Method of Whole-moulding.*

46 Method of whole-moulding. *Murray's Ship-Building.*

Having now finiſhed the methods of laying down the ſeveral plans of a ſhip, any farther addition on this ſubject might appear unneceſſary. We cannot, however, with propriety, omit to deſcribe the method called *whole-moulding*, uſed by the ancients, and which ſtill continues in uſe among thoſe unacquainted with the more proper methods already explained. This method will be illuſtrated by laying down the ſeveral plans of a long boat; the length of the keel being 29 feet, and breadth moulded nine feet.

47 Applied to a long boat. Plate ccccLxiii.

Draw the ſtraight line PO (fig. 37.) equal to 29 feet, the extreme length of the boat, and alſo to repreſent the upper edge of the keel. Let ⊕ be the ſtation of the midſhip frame. From the points P, ⊕, and O, draw the lines PT, ⊕M, and OS, perpendicular to PO. Make ⊕M, ⊕N, equal to the upper and lower heights of breadth reſpectively at the main frame, PT the height of breadth at the tranſom, and OS the height at the ſtem. Deſcribe the curve TMS to repreſent the ſheer or extreme height of the ſide, which in a ſhip would be called the *upper height of breadth line*, or upper edge of the wale. Through the point N draw a curve parallel to TMS, to repreſent the breadth of the upper ſtrake of a boat, or lower edge of the wale if in a ſhip. The dotted line TNS may alſo be drawn to repreſent the lower height of breadth.

Method of Whole-moulding.

Set off the rake of the port from P to *p*, and draw the line *p t* to repreſent the aft ſide of the port; then T *t* will repreſent the round up of the tranſom. Set off the breadth of the port from *p* to *r*, and from T to s, and draw the line *r* s to repreſent the foreſide of the port, which may either be a curve or a ſtraight line at pleaſure. Set up the height of the tuck from *p* to *k*. Let *k* X be the thickneſs of the tranſom, and draw the line ZX to repreſent the foreſide of the tranſom.

There is given the point S, the height of the ſheer on the foreſide of the ſtem; now that ſide of the ſtem is to be formed either by ſweeps or ſome other contrivance. Set off the breadth of the ſtem, and form the aft ſide of it.

Set up the dead-riſing from ⊕ to *d*, and form the riſing line r i s. Draw the line KL parallel to PO to repreſent the lower edge of the keel, and another to repreſent the thickneſs of the plank or the rabbet. The rabbet on the poſt and ſtem may alſo be repreſented; and the ſtations of the timbers aſſigned, as ⊗, (1), 1, 2, 3, 4, 5, 6, 7, 8, 9; and ⊕, (A), A, B, C, D, E, F, G, H; and the ſheer plan will be completed.

The half-breadth plan is to be formed next; for this purpoſe the perpendiculars TP, 9, 8, &c. muſt be produced. Upon M ⊕ produced ſet off the half breadth from the line KL to R (fig. 38.); ſet off alſo the half breadth at the tranſom from K to *b*, and deſcribe the extreme half breadth line *b* RX, making the forepart of the curve agreeable to the propoſed round of the tranſom.

We may next proceed to form the timbers in the body plan. Let AB (fig. 39.) be the breadth moulded at ⊕. Erect the perpendicular CD in the middle of the line AB; draw the line *m n* diſtant therefrom the half thickneſs of the poſt, and *x y* the half thickneſs of the ſtern. Then take off the ſeveral portions of the perpendiculars ⊕, 1, 2, &c. intercepted between the upper edge of the keel and the riſing line in the ſheer plan, and ſet them up from C upon the line CD; through theſe points draw lines parallel to AC; take off alſo the ſeveral lower heights of breadth at ⊕, 1, 2, &c. from the ſheer plan; and ſet them up from C upon the middle line in the body plan; and draw lines parallel to AC through theſe points: Then take off the ſeveral half breadths correſponding to each from the floor plan; and ſet them off on their proper half-breadth lines from the middle line in the body plan.

Conſtruct the midſhip frame by Problem V. the form of which will in ſome meaſure determine the form of the reſt. For if a mould be made on any ſide of the middle line to fit the curve part of it, and the riſing line, or that marked *bend mould* (fig. 40.), and laid in ſuch a manner that the lower part it, which is ſtraight, may be ſet upon the ſeveral riſing lines, and the upper part juſt touch the point of the half breadth in the breadth line correſponding to that riſing upon which the mould is placed, a curve may then be drawn by the mould to the riſing line. In this manner we may proceed ſo far as the riſing line is parallel to the lower height of the breadth line. Then a hollow mould muſt be made, the upper end of which is left ſtraight, as

that

Method of Whole-moulding.

that marked *hollow mould* (fig. 40.). This is applied in ſuch a manner, that ſome part of the hollow may touch the ſide of the keel, and the ſtraight part touch the back of the curve before deſcribed by the bend mould; and, beginning abaft, the ſtraight part will always come lower on every timber, till we come to the midſhip timber, when it comes to the ſide of the keel. Having thus formed the timbers, ſo far as the whole mouldings will ſerve, the timbers abaft them are next formed. Their half breadths are determined by the ſheer and floor plans, which are the only fixed points through which the curves of theſe timbers muſt paſs. Some form theſe after timbers before the whole is moulded, and then make the hollow mould, which will be ſtraighter than the hollow of either of theſe timbers. It is indifferent which are firſt formed, or what methods are uſed; for after the timbers are all formed, though every timber may appear very fair when conſidered by itſelf, it is uncertain what the form of the ſide will be. In order to find which, we muſt form ſeveral ribband and water lines; and if theſe do not make fair curves, they muſt be rectified, and the timbers formed from theſe ribband and water lines. In uſing the hollow mould, when it is applied to the curve of each timber, if the ſtraight part is produced to the middle line, we ſhall have as many points of interſection as there are timbers; and if the heights above the baſe be transferred to the correſponding timbers in the ſheer plan, a curve paſſing through theſe points is what is called a *riſing ſtrait*. This may be formed by fixing a point for the aftermoſt timber that is whole moulded, and transferring that height to the ſheer plan. The curve muſt paſs through this point, and fall in with the riſing line ſomewhere abaft dead flat; and if the ſeveral heights of this line be transferred from the ſheer to the middle line in the body plan, theſe points will regulate what is called the *hauling down* of the hollow mould.

The timbers in the after body being all formed, thoſe in the fore body are formed in the ſame manner, by transferring the ſeveral heights of the riſing and breadth lines from the ſheer to the body plan; the half breadths correſponding to each height muſt alſo be transferred from the floor to the body plan. The ſame hollow mould will ſerve both for the fore and after body; and the level lines, by which the water lines to prove the after body were formed, may be produced into the fore body, and by them, the water lines to prove the fore body, may be deſcribed.

Another method of proving the body is by ribband lines, which are formed by ſections of planes inclined to the ſheer plan, and interſecting the body plan diagonally, as before obſerved, of which there may be as many as may be judged neceſſary. As this has been already explained, we ſhall therefore lay down only one, repreſented in the body plan by the lines marked d i a. Theſe are drawn in ſuch a manner as to be perpendicular to as many timbers as conveniently may be. After they are drawn in the body plan, the ſeveral portions of the diagonal intercepted between the middle line and each timber muſt be transferrred to the floor plan. Thus, fix one foot of the compaſſes in the point where the diagonal interſects the middle line in the body plan; extend the other foot to the point where the diagonal interſects the timber; for example, timber 9: Set off the ſame extent upon the perpendicular repreſenting the plane of timber 9 from the point where it interſects the line KL on the floor plan: in like manner proceed with all the other timbers both in the fore and after body; and theſe ſhall have the points thro' which the curve muſt paſs. If this ſhould not prove a fair curve, it muſt be altered, obſerving to conform to the points as nearly as the nature of the curve will admit: ſo it may be carried within one point, and without another, according as we find the timbers will allow. For after all the ribband lines are formed, the timbers muſt, if needful, be altered by the ribband lines: this is only the reverſe of forming the ribband lines; for taking the portions of the ſeveral perpendiculars intercepted between the line KL and the curve of the ribband line in the floor plan, and ſetting them off upon the diagonal from the point where it interſects the middle line, we ſhall have the points in the diagonal through which the curves of the timbers muſt paſs. Thus the diſtance between the line KL and the ribband at timber 3 on the floor plan, when transferred to the body plan, will extend on the diagonal from the middle line to the point where the curve of timber 3 interſects that diagonal. The like may be ſaid of all the other timbers; and if ſeveral ribband lines be formed, they may be ſo contrived that their diagonals in the body plan ſhall be at ſuch diſtances, that a point for every timber being given in each diagonal, will be ſufficient to determine the form of all the timbers.

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In ſtationing the timbers upon the keel for a boat, there muſt be room for two futtocks in the ſpace before or abaft ⊗; for which reaſon, the diſtance between theſe two timbers will be as much more than that between the other as the timber is broad. Here it is between ⊕ and (A); which contains the diſtances between ⊕ and (1), and the breadth of the timber beſides.

The timbers being now formed, and proved by ribband and water lines, proceed then to form the tranſom, faſhion-pieces, &c. by Problem VI.

This method of whole-moulding will not anſwer for the long timbers afore and abaft. They are generally canted in the ſame manner as thoſe for a ſhip. In order to render this method more complete, we ſhall here deſcribe the manner of moulding the timbers after they are laid down in the mould loft, by a riſing ſquare, bend, and hollow mould.

It was ſhown before how to form the timbers by the bend and hollow moulds on the draught. The ſame method muſt be uſed in the loft; but the moulds muſt be made to their proper ſcantlings in real feet and inches. Now when they are ſet, as before directed, for moulding each timber, let the middle line in the body plan be drawn acroſs the bend mould, and draw a line acroſs the hollow mould at the point where it touches the upper edge of the keel; and let them be marked with the proper name of the timber, as in fig. 40. The graduations of the bend mould will therefore be exactly the ſame as the narrowing of the breadth. Thus, the diſtance between ⊗ and 7 on the bend mould is equal to the difference between the half breadth of timber 7 and that of ⊕. The height of the head of each timber is likewiſe marked on the bend mould, and alſo the floor and breadth firmarks. The floor firmark is in that point where a ſtraight edged batten touches the back of the bend mould, the batten being ſo placed

as

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as to touch the lower edge of the keel at the ſame time. The ſeveral riſings of the floor and heights of the cutting down line are marked on the riſing ſquare, and the half breadth of the keel ſet off from the ſide of it.

The moulds being thus prepared, we ſhall apply them to mould timber 7. The timber being firſt properly ſided to its breadth, lay the bend mould upon it, ſo as may beſt anſwer the round according to the grain of the wood; then lay the riſing ſquare to the bottom of the bend mould, ſo that the line drawn acroſs the bend mould at timber 7 may coincide with the line repreſenting the middle of the keel upon the riſing ſquare; and draw a line upon the timber by the ſide of the ſquare, or let the line be ſcored or cut by a tool made for that purpoſe, called a *raſeing knife* (E); this line ſo raſed will be the ſide of the keel. Then the ſquare muſt be moved till the ſide of it comes to 7 on the bend mould, and another line muſt be raſed in by the ſide of it to repreſent the middle of the keel. The other ſide of the keel muſt likewiſe be raſed after the ſame manner, and the point 7 on the riſing ſquare be marked on each ſide of the keel, and a line raſed acroſs at theſe points to repreſent the upper edge of the keel. From this line the height of the cutting down line at 7 muſt be ſet up, and then the riſing ſquare may be taken away, and the timber may be raſed by the bend mould, both inſide and outſide, from the head to the floor firmark; or it may be carried lower if neceſſary. After the firmarks and head of the timbers are marked, the bend mould may likewiſe be taken away, and then the hollow mould applied to the back of the ſweep in ſuch a manner that the point 7 upon it may interſect the upper ſide of the keel, before ſet off by the riſing ſquare; and when in this poſition the timber may be raſed by it, which will complete the outſide of the timbers. The inſide of the timbers may likewiſe be formed by the hollow mould. The ſcantling at the keel is given by the cutting down before ſet off. The mould muſt be ſo placed as to touch the ſweep of the inſide of the timber formed before by the bend mould, and paſs through the cutting down point.

The uſe of the firmarks is to find the true places of the futtocks; for as they are cut off three or four inches ſhort of the keel, they muſt be ſo placed that the futtock and floor firmarks may be compared and coincide. Notwithſtanding which, if the timbers are not very carefully trimmed, the head of the futtock may be either within or without its proper half breadth; to prevent which a half breadth ſtaff is made uſe of.

The half breadth ſtaff may be one inch ſquare, and of any convenient length. Upon one ſide of it are ſet off from one end the ſeveral half breadths of all the timbers in the after body, and thoſe of the fore body upon the oppoſite ſide. On the other two ſides are ſet off the ſeveral heights of the ſheer, the after body on one ſide, and the fore body on its oppoſite. Two ſides of the ſtaff are marked *half breadths*, and the other two ſides *heights of the ſheer*.

The ſtaff being thus prepared, and the floor-timbers ſaſtened on the keel, and levelled acroſs, the futtocks muſt next be faſtened to the floor timbers; but they muſt be ſet firſt to their proper half breadth and height. The half breadth ſtaff, with the aſſiſtance of the ram-line §, ſerves to ſet them to the half breadth: for as the keel of a boat is generally perpendicular to the horizon, therefore the line at which the plummet is ſuſpended, and which is moveable on the ram line, will be perpendicular to the keel. Whence we may by it ſet the timbers perpendicular to the keel, and then ſet them to their proper half breadths by the ſtaff: and when the two firmarks coincide, the futtock will be at its proper height, and may be nailed to the floor timbers, and alſo to the breadth ribband, which may be ſet to the height of the ſheer by a level laid acroſs, taking the height of the ſheer by the ſtaff from the upper ſide of the keel; by which means we ſhall diſcover if the ribband is exactly the height of the ſheer; and if not, the true height may be ſet off by a pair of compaſſes from the level, and marked on the timbers.

Practice of Ship-building.

§ See next Chapter.

Chap. VI. *Of the Practice of Ship-building.*

The elevation, projection, and half-breadth plans, of a propoſed ſhip being laid down on paper, we muſt next proceed to lay down theſe ſeveral plans on the mould loft of the real dimenſions of the ſhip propoſed to be built, and from which moulds for each ſeparate part are to be made. The method of laying down theſe plans, from what has been already ſaid, will, it is preſumed, be no very difficult taſk to accompliſh, as it is no more than enlarging the dimenſions of the original draughts; and with reſpect to the moulds, they are very eaſily formed agreeable to the figure of the ſeveral parts of the ſhip laid down in the mould loft.

Blocks of wood are now to be prepared upon which the keel is to be laid. Theſe blocks are to be placed at nearly equal diſtances, as of five or ſix feet, and in ſuch a manner that their upper ſurfaces may be exactly in the ſame plane, and their middle in the ſame ſtraight line. This laſt is eaſily done by means of a line ſtretched a little more than the propoſed length of the keel; and the upper planes of theſe blocks may be verified by a long and ſtraight rule; and the utmoſt care and precaution muſt be taken to have theſe blocks properly bedded. Each block may be about ſix or eight inches longer than the keel is in thickneſs; their breadth from 12 to 14 inches, and their depth from a foot to a foot and half.

The dimenſions of the keel are to be taken from the mould loft, and the keel is to be prepared accordingly. As, however, it is ſeldom poſſible to procure a piece of wood of ſufficient length for a keel, eſpecially if for a large ſhip, it is, therefore, for the moſt part neceſſary to compoſe it of ſeveral pieces, and theſe pieces are to be ſcarfed together, and ſecurely bolted, ſo as to make one entire piece. It muſt, however, be obſerved, that the pieces which compoſe the keel ought to be of ſuch lengths, that a ſcarf may not be oppoſite to the ſtep of any of the maſts. Rabbets are to be formed on each ſide of the keel to receive the edge of the planks next to

(E) The term *raſeing* is uſed when any line is drawn by ſuch an inſtrument inſtead of a pencil.

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to it, or garboard ſtrake, and the keel is to be laid on the blocks (F).

The ſtem, and the poſt, and the ſeveral tranſoms belonging to it, are to be prepared from the moulds, and rabbeted in like manner as the keel, to receive the ends of the plank. The tranſoms are to be bolted to the poſt at their middle, each at its reſpective height, taken from the elevation in the mould loft, and the extremities of the tranſoms are to be firmly connected with the faſhion-pieces. Both ſtem and poſt are then to be erected, each at its reſpective extremity of the keel. The tenons at the heel of each being let into mortiſes prepared to receive them, and being ſet to their proper rakes or angles with the keel, are to be ſupported by props or ſhores. Pieces of wood called *dead wood* are to be laid upon and fixed to the upper ſide of the keel towards the fore and aft parts of it; the deepneſs of the dead wood increaſing with its diſtance from the middle, agreeable to the propoſed form of the cutting down line.

A line is to be ſtretched from the middle of the head of the ſtem to that of the poſt, called the *ram line*, upon which is a moveable line with a plummet affixed to it. The midſhip and other frames are to be erected upon the keel at their proper ſtations. The extremities of each frame are ſet at equal diſtances from the vertical longitudinal ſection of the ſhip, by moving the frame in its own plane until the plumb-line coincides with a mark at the middle between the arms of each frame; and although the keel is inclined to the horizon, yet the frames may alſo be ſet perpendicular to the keel by means of the plumb-line. The ſhores which are ſupporting the frames are now to be ſecurely fixed, that the poſition of the frames may not be altered. The ribbands are now to be nailed to the frames at their proper places, the more effectually to ſecure them; and the intermediate vacancies between the frames filled up with filling timbers. For a perſpective view of a ſhip framed, ſee Plate CCCCLIV. fig. 2.

The frames being now ſtationed, proceed next to fix on the planks, of which the wales are the principal, being much thicker and ſtronger than the reſt, as is repreſented in the midſhip frame, Plate CCCXIV The harpins, which may be conſidered as a continuation of the wales at their fore ends, are fixed acroſs the hawſe pieces, and ſurround the fore part of the ſhip. The planks that incloſe the ſhip's ſides are then brought about the timbers; and the clamps, which are of equal thickneſs with the wales, fixed oppoſite to the wales within the ſhip. Theſe are uſed to ſupport the ends of the beams, and accordingly ſtretch from one end of the ſhip to the other. The thick ſtuff or ſtrong planks of the bottom within board are then placed oppoſite to the ſeveral ſcarfs of the timbers, to reinforce them throughout the ſhip's length. The planks employed to line the ſhip, called the *ceiling* or *foot-waling*, is next fixed in the intervals between the thick ſtuff of the hold. The beams are afterwards laid acroſs the ſhip to ſupport the decks, and are connected to the ſide by lodging and hanging knees: the former of which are exhibited at F, Plate CLVI. See alſo the article DECK; and the hanging-knees, together with the breadth, thickneſs, and poſition of the keel, floor timbers, futtocks, top-timbers, wales, clamps, thick ſtuff, planks within and without, beams, decks, &c. are ſeen in the midſhip frame, Plate CCCXIV. and in that article theſe ſeveral parts have already been explained.

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The cable-bits being next erected, the *carlings* and *ledges*, repreſented in Plate CLVI. are diſpoſed between the beams to ſtrengthen the deck. The *water-ways* are then laid on the ends of the beams throughout the ſhip's length, and the ſpirketing fixed cloſe above them.—The upper deck is then planked, and the *ſtring* placed under the *gunnel*, or *planſheer*, in the waiſt. The diſpoſition of thoſe latter pieces on the timbers, viz. the water-ways, ſpirketing, upper deck, ſtring, and gunnel, are alſo repreſented in the midſhip frame, Plate CCCIV.

Then proceed next to plank the quarter-deck and forecaſtle, and to fix the *partners* of the maſts and capſterns with the *coamings* of the hatches. The *breaſt-hooks* are then bolted acroſs the ſtem and bow within-board, the ſtep of the foremaſt placed on the kelſon, and the *riders*, exhibited in the MIDSHIP FRAME, fayed to the inſide of the timbers, to reinforce the ſides in different parts of the ſhip's length. The *pointers*, if any, are afterwards fixed acroſs the hold diagonally to ſupport the beams; and the crotches ſtationed in the after hold to unite the half timbers. The *ſteps* of the mainmaſt and capſterns are next placed; the planks of the lower decks and orlop laid; the *navel-hoods* fayed to the hawſe holes; and the *knees of the head*, or cut-water, connected to the ſtern. The figure of the head is then erected, and the *trail-board* and cheeks fixed on the ſide of the knee.

The *taffarel* and *quarter-pieces*, which terminate the ſhip abaft, the former above and the latter on each ſide, are then diſpoſed, and the ſtern and quarter galleries framed and ſupported by their brackets. The *pumps*, with their well, are next fixed in the hold; the *limber boards* laid on each ſide of the kelſon, and the *garboard ſtrake* fixed on the ſhip's bottom next to the heel without.

The hull being thus fabricated, proceed to ſeparate the apartments by bulkheads or partitions, to frame the port-lids, to fix the catheads and cheſs-trees; to form the hatchways and ſcuttles, and fit them with proper covers or gratings. Next fix the ladders at the different hatchways, and build the manger on the lower deck; to carry off the water that runs in at the hawſe-holes when the ſhip rides at anchor in a ſea. The bread-room and magazines are there lined; and the gunnel, rails, and gangways fixed on the upper part of the ſhip. The cleats, kevels, and ranges, by which the ropes are faſtened, are afterwards bolted or nailed to the ſides in different places.

The rudder, being fitted with its irons, is next hung to the ſtern-poſt, and the tiller or bar, by which it is managed, let into a mortiſe at its upper end. The *ſcuppers*,

(F) In ſhips of war, which are a long while in building, it has been found that the keel is often apt to rot before they are finiſhed. Upon this account, therefore, ſome builders have begun with the floor timbers, and added the keel afterwards.

Improvements in the Masts and Rudder.

scuppers, or leaden tubes, that carry the water off from the decks, are then placed in holes cut through the ship's sides; and the *standards* represented in the MIDSHIP FRAME, Plate CCCXIV. bolted to the beams and sides above the decks to which they belong. The poop lanthorns are last fixed upon their cranes over the stern, and the *bilge-ways* or *cradles* placed under the bottom to conduct the ship steadily into the water whilst launching.

As the various pieces which have been mentioned above are explained at large in their proper places, it is therefore superfluous to enter into a more particular description of them here.

CHAP. VII. *Of Improvements in the Masts and Rudder.*

48 Improvements in masts.

49 Of wounded masts by Captain Pakenham.

SINCE the article MAST was printed, an account of a method for restoring masts of ships when wounded, or otherwise injured, in an easy, cheap, and expeditious manner, by Captain Edward Pakenham of the royal navy, has been published in the tenth volume of the Transactions of the Society for the Encouragement of Arts, &c. Captain Pakenham introduces his invention with the following observations:

Page 209. "Among the various accidents which ships are liable to at sea, none call more for the attention and exertion of the officer than the speedy refitting of the masts; and having observed, in the course of last war, the very great destruction made among the lower masts of our ships from the enemy's mode of fighting, as well as the very great expence and delay in refitting a fleet after an action, particularly across the Atlantic—a very simple expedient has suggested itself to me as a resource in part; which appears so very speedy and secure, that the capacity of the meanest sailor will at once conceive it. I therefore think it my duty to state my ideas of the advantages likely to result from it; and I shall feel myself exceedingly happy should they in anywise contribute to remedy the evil.

"My plan, therefore, is, to have the heels of all lower masts so formed as to become the heads: but it is not the intention of the above plan to have the smallest alteration made in the heels of the present lower masts; for as all line-of-battle ships masts are nine inches in diameter larger at the heel than at the head, it will follow, that by letting in the tressel-trees to their proper depth, the mast will form its own cheeks or hounds; and I flatter myself the following advantages will result from the above alteration.

First, I must beg to observe, that all line-of-battle ships bury one-third of their lower masts, particularly three-deckers; it therefore follows, that if the wounds are in the upper third, by turning the mast so as to make the heel the head, it will be as good as new; for, in eight actions I was present in last war, I made the following observations:

"That in the said actions fifty-eight lower masts were wounded, and obliged to be shifted, thirty-two of which had their wounds in the upper third, and of course the ships detained until new masts were made. And when it is considered that a lower mast for a 90 or 74 stands government in a sum not less, I am informed, than 2000 l. to 2300 l. the advantages across the Atlantic resulting from the aforesaid plan will be particularly obvious; not to mention the probability of there being no fit spars in the country, which was the case in the instances of the Isis and Princess Royal; and as I was one of the lieutenants of the Isis at that time, I am more particular in the circumstance of that ship. The Isis had both her lower masts wounded above the cathar pins in her action with the Cæsar, a French 74; and as there were no spars at New York, the Isis was detained five weeks at that place.—Now, if her masts had been fitted on the plan I have proposed, I am confident she would have been ready for sea in 48 hours; and as a further proof, I beg leave to add, that the whole fleet, on the glorious 12th of April, had not the least accident of any consequence except what befel their lower masts, which detained them between eight and ten weeks at Jamaica.

Improvements in the Masts and Rudder.

"The delay of a ship while a new mast is making, and probably the fleet being detained for want of that ship, which frequently occurred in the course of last war, the taking of shipwrights from other work, with a variety of inconveniences not necessary to mention here, must be obvious to every officer that has made the smallest observations on sea actions.

"You will further observe, that this substitute is formed on the most simple principle, fitted to the meanest capacity, and calculated to benefit all ships, from a first-rate down to the smallest merchantman, in cases of an accident by shot, a spring, a rottenness, particularly as these accidents generally happen in the upper third of the mast and above the cheeks.

"It might probably be objected, that a difficulty and some danger might arise from the wounded part of the mast being below; but this will at once be obviated, when it is remembered, that as the wounded part is below the wedges, it may with ease be both fished, cased, and secured, to any size or degree you please, with the addition of its being wedged on each deck."

Fig. 41. represents a mast of a first-rate in its proper state, the figures representing its thickness at the different divisions.

Fig. 42. the same mast inverted, the heel forming the head, and the tressel-trees let into their proper depth, the additional thickness of the mast forming its own cheeks.

Fig. 43. the proposed mast, the figures representing the thickness of the mast in the proposed alterations; *a*, the heel made square; *b*, the letting in of the tressel-trees; *c*, the third proportion of thickness continued up to where the fourth is in the present mast, or at least some little distance above the lower part of the cheeks, which is always looked upon as the weakest part of the mast; and by its being so proportioned, the mast, when turned, will be nearly as strong in the partners as before.

As the expence of a mast is much greater than is generally imagined, it is therefore thought proper to subjoin the following statement of the several articles used in making a 74 gun ship's mainmast.

	Value.			
Fishes for a spindle, 21 inches, 2 nails of two masts, - -	L.	101	3	11
Two side fishes, 22 inches, 2 ditto,		133	10	9
Fore and aft fishes, 22 inches, 2 nails of one mast, - -		66	13	10
Fish } 21½ inches, 1 nail of half a mast, On the fore part.		29	8	5
Iron } 3 qrs 19 lbs		1	5	9
Aries load baulk, 2 loads 22 feet, -		12	2	5
	L.	344	5	1

Papers on Naval Architecture, part 2.

Improvements in the Masts and Rudder.

		Value.		
	Brought over	L. 344	5	1
Breadthning	2 loads 7 feet, Dantzic fir timber.	11	1	7
Cheeks	4 loads 2 feet,	20	18	4
Iron, 5 cwt. 2 qrs 24 lb.	-	8	0	0
Knees, elm timber, 13 feet,	-	0	15	2
Iron, 2 qrs. 14 lb.	- -	0	17	6
Hoops and bolts on the body, 13 cwt. 1 qr. 16 lb.	-	18	15	0
Treffel trees, ſtraight oak timber, ſecond ſort, 2 loads 10 feet,	- -	10	2	4
Iron, 3 qrs. 10 lb.	-	1	3	6
Croſs trees, ſtraight oak timber, ſecond ſort 1 load 12 feet,	- -	5	14	0
Iron, 2 qrs. 2 lb.	- -	0	14	6
Cap, elm timber, 1 load 24 feet,	-	4	6	0
Iron, 2 cwt. 14 lb.	-	2	19	6
Fullings, bolſters, bollins, and Dantzic fir, 1 load 2 feet,	- -	5	7	8
Workmanſhip,	- -	78	6	0
		L. 513	6	2
Main-topmaſt of a 74 gun ſhip,		50	16	3
Main top-gallant-maſt,		8	11	0

Principles of Naval Architecture, p. 50.

50 Mr Gordon's plan of building maſts.

In order to leſſen the enormous expence of maſts, a propoſal was made ſome years ago to conſtruct them hollow; and the author having premiſed ſeveral experiments which he had made, proceeds as follows:

"Galileo taught us, that the reſiſtance or ſtrength of a hollow cylinder is to that of a full cylinder, containing the ſame quantity of matter, as the total diameter of the hollow one is to the diameter of the full one; and theſe experiments ſhow us, that the ſtrength or reſiſtance of two or more pieces of wood, faſtened together at each end, and connected by a pillar, pillars, or framing, increaſes, at leaſt to a certain degreee, *cæteris paribus*, as the diſtance between them and number of pillars, provided the force is applied in the line or direction of the pillars.

"It is ſurpriſing that this diſcovery of Galileo has not been made ſubſervient to more uſeful purpoſes. It is particularly applicable to the conſtruction of maſts, as not requiring that the hollow cylinder ſhould be made of one ſolid piece of wood (G).

"However, the foregoing experiments teach us, that the ſame advantages may be obtained by other forms beſides that of a cylinder; and that perhaps not only in a ſuperior degree, but likewiſe with greater facility of execution; as by adopting a ſquare figure, but more particularly by conſtructing them of ſeparate pieces of wood, placed at proper diſtances from each other, in the following or any other manner that may be found moſt convenient. Fig. 44, 45, and 46, exhibit each the tranſverſe ſection of a maſt, in which the ſmall circles repreſent the trees or upright pieces of wood, and the lines the beams or framing of wood, which are employed at proper places and at proper diſtances from each other, for connecting them together. Perhaps ſolid frames of wood, placed at proper diſtances from each other, and filling up the whole dotted ſpace, would anſwer better; in which event, the maſt could be ſtrongly hooped with iron at thoſe places, and the upright trees formed ſquare, or of any other convenient form.

Improvements in the Masts and Rudder.

"It will be evident to thoſe acquainted with this ſubject, that ſuch maſts would be greatly ſtronger than common ones containing the ſame quantity of materials. It is likewiſe evident that they would be leſs apt to ſpring, as being ſupported on a more extended baſe, and affording many conveniences for being better ſecured; and that they might be conſtructed of ſuch wood as at preſent would be deemed altogether improper for maſts: a circumſtance of importance to Britain at all times, but more particularly now, when there is ſuch difficulty in procuring wood proper for the kind of maſts in common uſe."

51 An improvement in the rudder.

An improvement in the rudder has lately taken place in ſeveral ſhips, particularly in ſome of thoſe in the ſervice of the Eaſt India company. It will, however, be neceſſary previouſly to deſcribe the uſual form of the rudder, in order to ſhow the advantages it poſſeſſes when conſtructed agreeable to the improved method.

Papers on Naval Architecture, part 1.

N° 1. (fig. 47) repreſents the rudder according to the common method of conſtruction; in which AB is the axis of rotation. It is hence evident that a ſpace conſiderably greater than the tranſverſe ſection of the rudder at the counter muſt be left in the counter for the rudder to revolve in. Thus, let CAB (n° 2.) be the ſection of the rudder at the counter; then there muſt be a ſpace ſimilar to CDE in the counter, in order that the rudder may be moveable as required. Hence, to prevent the water from waſhing up the rudder caſe, a rudder coat, that is, a piece of tarred canvas, is nailed in ſuch a manner to the rudder and counter as to cover the intermediate ſpace: but the canvas being continually waſhed by the ſea, ſoon becomes brittle, and unable to yield to the various turns of the rudder without breaking; in which caſe the ſhip is of courſe left pervious to the waves, even of three or four feet high; in fact, there are few men bred to the ſea who have not been witneſſes to the bad effects of ſuch a ſpace being left ſo ill guarded againſt the ſtroke of the waves; and many ſhips have, with great probability, been ſuppoſed to founder at ſea from the quantity of water ſhipped between the rudder and counter.

It was to remedy this defect that the alteration above alluded to took place; which conſiſts in making the upper part AFG (fig. 48, n° 1.) of the rudder ABD cylindrical, and giving that part at the ſame time a caſt forward, ſo that the axis of rotation may by that means be the line AD, paſſing as uſual from E to D, through the centres of the braces which attach the rudder to the ſtern-poſt, and from E to A through the axis

(G) The ſtrength of theſe cylinders would be ſtill further augmented by having ſolid pieces of wood placed within them at proper diſtances, and ſecurely faſtened to them, in the ſame manner, and on the ſame principles, that nature has furniſhed reeds with joints; and for anſwering, in ſome reſpects, the ſame purpoſe as the pillars in the experiments alluded to.

Load-water Line and Ship's Capacity.

axis the cylinder AFG, in order that the tranſverſe ſection KH (n° 2.) at the counter may be a circle revolving upon its centre; in which caſe the ſpace of half an inch is more than ſufficient between the rudder and the counter, and conſequently the neceſſity of a rudder coat entirely done away. But as it was foreſeen, that if the rudder by any accident was unſhipped, this alteration might endanger the tearing away of the counter, the hole is made much larger than the tranſverſe ſection of the cylindric part of the rudder, and the ſpace between filled up with pieces of wood ſo fitted to the counter as to be capable of withſtanding the ſhock of the ſea, but to be eaſily carried away with the rudder, leaving the counter, under ſuch circumſtances, in as ſafe a ſtate as it would be agreeable in the preſent form of making rudders in the navy.

CHAP. VIII. *Upon the Poſition of the Load-water Line, and the Capacity of a Ship.*

See Hydroſtatics.

THE weight of the quantity of water diſplaced by the bottom of a ſhip is equal to the weight of the ſhip with its rigging, proviſions, and every thing on board. If therefore the exact weight of the ſhip when ready for ſea be calculated, and alſo the number of cubic feet in the ſhip's bottom below the load-water line, and hence the weight of the water ſhe diſplaces; it will be known if the load-water line is properly placed in the draught.

Ship-Builder's Repoſitory.

The poſition of the ſhip in the draught may be either on an even keel, or to draw moſt water abaft; but an even keel is judged to be the beſt poſition in point of velocity, when the ſhip is conſtructed ſuitable thereto, that is, when her natural poſition is ſuch. For when a ſhip is conſtructed to ſwim by the ſtern, and when brought down to her load-water made to ſwim on an even keel (as is the caſe with moſt ſhips that are thus built), her velocity is by that means greatly retarded, and alſo her ſtrength greatly diminiſhed: for the forepart being brought down lower than it ſhould be, and the middle of the ſhip maintaining its proper depth in the water, the after part is by that means lifted, and the ſhip is then upon an even keel: but in conſequence of her being out of her natural poſition, the after part is always preſſing downwards with a conſiderable ſtrain, which will continue till the ſhip's ſheer is entirely broke, and in time would fall into its natural poſition again: for which reaſon we ſee ſo many ſhips with broken backs, that is, with their ſheers altered in ſuch a manner that the ſheer rounds up, and the higheſt part is in the midſhips.

Such are the diſadvantages ariſing from not paying a due attention to thoſe points in the conſtruction of a draught; therefore, when the load-water line is found to be ſo ſituated at a proper height on the draught, according to the weight given for ſuch a ſhip, and alſo drawn parallel to the keel, as ſuppoſing that to be the beſt ſailing trim, the next thing is to examine whether the body is conſtructed ſuitable thereto, in order to avoid the above-mentioned ill conſequences.

In the firſt place, therefore, we muſt divide the ſhip equally in two lengthwiſe between the fore and after perpendiculars; and the exact number of cubic feet in the whole bottom beneath the load-water line being known, we muſt find whether the number of cubic feet in each part ſo divided are the ſame; and if they are found to be equal, the body of the ſhip may then be ſaid to be conſtructed in all reſpects ſuitable to her ſwimming on an even keel, let the ſhape of the body be whatever it will; and which will be found to be her natural poſition at the load-water line. But if either of the parts ſhould contain a greater number of cubic feet than the other, that part which contains the greateſt will ſwim the moſt out of the water, and conſequently the other will ſwim deepeſt, ſuppoſing the ſhip in her natural poſition for that conſtruction. In order, therefore, to render the ſhip ſuitably conſtructed to the load-water line in the draught, which is parallel to the keel, the number of cubic feet in the leſs part muſt be ſubtracted from the number contained in the greater part, and that part of the body is to be filled out till it has increaſed half the difference of their quantities, and the other part is to be drawn in as much: hence the two parts will be equal, that is, each will contain the ſame number of cubic feet, and the ſhip's body will be conſtructed in a manner ſuitable to her ſwimming on an even keel.

Load-water Line and Ship's Capacity.

If it is propoſed that the ſhip laid down on the draught ſhall not ſwim on an even keel, but draw more water abaft than afore, then the fore and after parts of the ſhip's body below the load-water line are to be compared; and if theſe parts are unequal, that part which is leaſt is to be filled out by half the difference, and the other part drawn in as much as before.

It will be neceſſary, in the firſt place, to calculate the weight of a ſhip ready equipped for ſea, from the knowledge of the weight of every ſeparate thing in her and belonging to her, as the exact weight of all the timber, iron, lead, maſts, ſails, rigging, and in ſhort all the materials, men, proviſions, and every thing elſe on board of her, from which we ſhall be able afterwards to judge of the truth of the calculation, and whether the load-water line in the draught be placed agreeable thereto. This is indeed a very laborious taſk, upon account of the ſeveral pieces of timber, &c. being of ſo many different figures, and the ſpecific gravity of ſome of the timber entering the conſtruction not being preciſely determined.

In order to aſcertain the weight of the hull, the timber is the firſt thing which comes under conſideration: the number of cubic feet of timber contained in the whole fabric muſt be found; which we ſhall be able to do by help of the draught and the principal dimenſions and ſcantlings; obſerving to diſtinguiſh the different kinds of timber from each other, as they differ conſiderably in weight; then the number of cubic feet contained in the different ſorts of timber being reduced into pounds, and added, will be the weight of the timber. In like manner proceed to find the weight of the iron, lead, paint, &c. and the true weight of the whole will be found.

In reducing quantity to weight, it may be obſerved that a cubic foot of oak is equal to 66 pounds, and the ſpecific gravity of the other materials are as follow: *See Hydroſtatics.*

Water being		1000	Oak is	891.89
Lead is	-	11345	Dry elm	702.70
Iron	-	7643	Dry fir	648.64

Load-water Line and Ship's Capacity.

An Eſtimate of the Weight of the Eighty Gun Ship in Plates CCCCLX. and CCCCLXI. *as fitted for Sea, with ſix Months Proviſions.*

Weight of the Hull.

52 Eſtimate of the weight of the eighty gun ſhip before laid down.

	N° of Ft.	N° of lbs.	Tons.	Lbs.
Oak timber at 66 lb. to the cubic foot	48497	3200802	1428	2082
Fir timber at 48 lb. to the cubic foot	4457	213936	95	1136
Elm timber at 52 lb. to the cubic foot	520	27040	12	160
Carve work and lead work		4651	2	171
Iron work, rudder irons, chain-plates, nails, &c.		88254	39	894
Pitch, tar, oakum, and paint		17920	8	
Cook-room fitted with fire hearth		16123	7	443
Sum		3568726	1593	406

Weight of the Furniture.

	N° of lb.	Tons.	Lbs.
Complete ſet of maſts and yards, with the ſpare geer	161000	71	1960
Anchors with their ſtocks, and maſter's ſtores	39996	17	1916
Rigging	69128	30	1928
Sails, complete ſet, and ſpare	32008	14	648
Cables and hawſers	73332	32	1652
Blocks, pumps, and boats	62056	27	1576
Sum	437520	195	720

Weight of the Guns and Ammunition.

Guns with their carriages	377034	168	714
Powder and ſhot, powder barrels, &c.	116320	51	2080
Implements for the powder	6500	2	2020
Ditto for guns, crows, handſpikes, &c.	21573	9	1413
Sum	521427	232	1747

Weight of the Officers Stores, &c.

Carpenter's ſtores	20187	9	27
Boatſwain's ſtores	21112	9	952
Gunner's ſtores	8964	4	4
Caulker's ſtores	5200	2	720
Surgeon and chaplain's effects	11096	4	2136
Sum	66559	29	1599

Weight of the Proviſions.

Proviſions for ſix months for 700 men, with all their equipage	858970	383	1050
Water, caſks, and captain's table	933900	416	2060
Sum	1792870	800	870

Load-water Line and Ship's Capacity.

Weight of the Men, &c.

	N° of lbs.	Tons.	Lbs.
Seven hundred men with their effects, including the officers and their effects	316961	141	1121
Ballaſt	1478400	660	
Sum	1795361	801	1121

Recapitulation.

The hull	3568726	1593	406
The furniture	437520	195	720
Guns and ammunition	521427	232	1747
Officers ſtores	66559	29	1599
Proviſions	1792870	800	870
Weight of the men and ballaſt	1795361	801	1121
Sum	8182463	3652	1983

Agreeable to the above eſtimate, we find that the eighty gun ſhip, with every thing on board and fit for ſea, when brought down to the load water line, weighs 8,182,463 pounds, or nearly 3653 tons. It may now be known if the load water line in the draught be properly placed, by reducing the immerſed part of the body into cubic feet. For if the eighty gun ſhip, when brought down to the load water line, weighs 3653 tons, the quantity of water diſplaced muſt alſo be 3653 tons: now a cubic foot of ſalt water being ſuppoſed to weigh 74 pounds, if therefore 8182463 be divided by 74, the quotient is 110573, the number of cubical feet which ſhe muſt diſplace agreeable to her weight.

It is now neceſſary to find the number of cubic feet contained in the ſhip's bottom below the load water line by calculation. If the bottom was a regular ſolid, this might be very eaſily done; but as it is otherwiſe, we muſt be ſatisfied with the following method by approximation, firſt given by M. Bouguer.

53 Method of calculating the content of the bottom of a ſhip.

Take the lengths of every other of the lines that repreſent the frames in the horizontal plane upon the upper water line; then find the ſum of theſe together, with half the foremoſt and aftermoſt frames. Now multiply that ſum by the diſtance between the frames, and the product is the area of the water line contained between the foremoſt and aftermoſt frames: then find the area of that part abaft the after frame, which forms a trapezium, and alſo the poſt and rudder; find alſo the area of that part afore the foremaſt frame, and alſo of the ſtem and gripe; then theſe areas being added to that firſt found, and the ſum doubled, will be the area of the ſurface of the whole water line. The reaſon of this rule will be obvious to thoſe acquainted with the firſt principles of mathematics.

The areas of the other water line may be found in the ſame manner: then the ſum of all theſe areas, except that of the uppermoſt and lowermoſt, of which only one half of each muſt be taken, being multiplied by the diſtance between the water lines (theſe lines in the plane of elevation being equidiſtant from each other), and the product will be the ſolid content of the ſpace contained between the lower and load water lines.

Add

Load-water Line and Ship's Capacity.

Add the area of the lower water line to the area of the upper ſide of the keel; multiply half that ſum by the diſtance between them, the product will be the ſolid content of that part between the lower water line and upper edge of the keel, ſuppoſing them parallel to each other. But if the lower water line is not parallel to the keel, the above half ſum is to be multiplied by the diſtance between them at the middle of the ſhip.

The ſolid contents of the keel muſt be next found, by multiplying its length by its depth, and that product by the breadth. Then the ſum of theſe ſolid contents will be the number of cubic feet contained in the immerſed part of the ſhip's bottom, or that part below the load water line.

Determination of the number of Cubic Feet contained in the Bottom of the Eighty Gun Ship. See Plates CCCCLX. and CCCCLXI.

54 Applied to the eighty gun ſhip.

The fore body is divided into five, and the after body into ten, equal parts in the horizontal plane; beſides the parts contained between the foremoſt timber and the ſtem, and the aftermoſt timber and the poſt. The plane of elevation is alſo divided into five equal parts by water lines drawn parallel to the keel. Theſe water lines are alſo deſcribed upon the horizontal plane.

It is to be obſerved that there muſt be five inches added to each line that repreſents a frame in the horizontal plane for the thickneſs of the plank, that being nearly a mean between the thickneſs of the plank next the water and that on the lower part of the bottom.

Upper Water Line abaft Dead Flat.

	Ft.	In.
The breadth at frame dead flat is 24 f. 10 in. one half of which is	12	5
frame (4)	24	10
frame 3	24	10
frame 7	24	10
frame 11	24	10
frame 15	24	9½
frame 19	24	5
frame 23	23	10
frame 27	22	9
frame 31	20	11
frame 35 is 16 feet 3 inches, the half of which is	8	1½
Sum	236	7
Diſtance between the frames	10	11
Product	2582	8½
Area of that part abaft frame 35	78	0
rudder and poſt	5	6
Sum	2666	2½
		2
Area of the load water line from dead flat aft	5332	5

Second Water Line abaft Dead Flat.

	Ft.	In.
The breadth at frame dead flat is 23 feet 10½ inches, the half of which is	11	11¼
frame (4)	23	10½
frame 3	23	10½
frame 7	23	10½
frame 11	23	10½
frame 15	23	8½
frame 19	23	3½
frame 23	22	5
frame 27	20	10
frame 31	17	8
frame 35 is 8 feet 6 inches, the half of which is	4	3
Sum	219	7¼
Diſtance between the frames	10	11
Product	2397	4
Area of that part abaft frame 35	31	7
rudder and poſt	5	5
Sum	2434	4
		2
Area of the 2d water line from dead flat aft	4868	8

Third Water Line abaft Dead Flat.

	Ft.	In.
The breadth at frame dead flat is 22 feet 1½ inches—half	11	0¾
frame (4)	22	1½
frame 3	22	1½
frame 7	22	1½
frame 11	22	1
frame 15	21	5
frame 19	20	8½
frame 23	19	3½
frame 27	16	5
frame 31	11	2½
frame 35 is 4 feet 3 inches—half	2	1½
	190	8¼
	10	11
	2081	8
Area of that part abaft frame 35	14	5½
rudder and poſt	5	6
	2101	7½
		2
Area of the 3d water line from dead flat aft	4203	3

Fourth Water Line abaft Dead Flat.

	Ft.	In.
The breadth at frame deadflat is 20 feet 1 inch—half	10	0½
frame (4)	20	1
frame 3	20	1
frame 7	19	11
frame 11	19	7½
frame 15	19	0
Carry over	108	9

Load-water Line and Ship's Capacity.

Brought

414 Load water Line and Ship's Capacity.

	Ft.	In.
Brought over	108	9
Breadth at frame 19	17	7½
Breadth at frame 23	14	10
Breadth at frame 27	10	11
Breadth at frame 31	5	11
Breadth at frame 35 is 1 foot 11½ inches—half	0	11½
	159	0
	10	11
	1735	9
Area of that part abaft frame 35	9	9
rudder and poſt	5	0
	1750	6
		2
Area of the 4th water line from dead flat aft	3501	0

Fifth or Lower Water Line abaft Dead Flat.

	Ft.	In.
The breadth at frame dead flat is 17 feet 2 inches—half	8	7
frame (4)	17	2
frame 3	17	2
frame 7	17	1
frame 11	16	4
frame 15	15	4
frame 19	13	1
frame 23	8	9
frame 27	4	10
frame 31	2	11
frame 35 is 1 foot 2½ inches—half	0	7¼
	121	10¼
	10	11
	1330	2
Area of that part abaft frame 35	4	8½
rudder and poſt	4	6½
	1339	5
		2
Area of the 5th or lower water line from dead flat aft	2678	10
Half the area of the load water line	2666	2½
Area of the ſecond water line	4868	8
Area of the third water line	4203	3
Area of the fourth water line	3501	0
Half the area of the lower water line	1339	5
Sum	16578	6½
Diſtance between the water lines	4	1
Content in cubic feet between the lower and load water lines	67695	8½
Area of the lower water line 2678 10		
Area of the upper ſide of the keel 206 4		
Sum 2885 2		
Half 1442 7		
Diſtance between the lower water line and the keel 4 1		
Cub. feet contained between lower water line and the keel 5890 6½	5890	6½
Content of the keel, lower part of rudder, and falſe keel	464	3
Cubic feet abaft the midſhip frame under water when loaded	74050	6

Upper or Load water Line afore Dead Flat.

	Ft.	In.
The breadth at frame dead flat is 24 feet 10 inches—half	12	5
frame E	24	10
frame I	24	8½
frame N	24	0
frame Q	21	10½
frame W is 15 feet 1 inch—half	7	6½
Sum	115	4½
Diſtance between the frames	10	11
Product	1259	6
Area of the part afore frame W	80	3
ſtem and knee	4	0
Sum	1343	9
Multiply by		2
Area of the load water line from dead flat forward	2687	6

Second Water Line afore Dead Flat.

	Ft.	In.
The breadth at frame deadflat is 23 feet 10½ inches—half	11	11¼
frame E	23	10
frame I	23	5
frame N	22	5
frame Q	19	11
frame W is 11 feet 11 inches—half	5	11½
Sum	107	5¾
Diſtance between the frames	10	11
Product	1173	9
Area of the part afore frame W, with the ſtem and knee	43	9
Sum	1217	6
		2
Area of the ſecond water line from dead flat forward	2435	0

Third Water Line afore Dead Flat.

	Ft.	In.
The breadth at frame dead flat is 22 feet 1¼ inch—half	11	0¾
frame E	22	1
frame I	21	8
frame N	20	1
frame Q	16	1½
frame W is 7 feet—half	3	6
Sum	94	6¼
Diſtance between the frames	10	11
Product	1031	10
Area of the part afore W, with the ſtem and gripe	25	10
Sum	1057	8
		2
Area of the third water line from dead flat forward	2115	4

Load water Line and Ship's Capacity.

Load-water Line and Ship's Capacity.

Fourth Water Line afore Dead Flat.

	Ft.	In.
The breadth at frame dead flat is 20 feet 1 inch—half	10	0½
frame E - -	20	0½
frame I - - -	19	3
frame N - -	16	5
frame Q - -	11	2
frame W is 2 feet 9 inches—half	1	4½
Sum - -	78	3½
Diſtance between the frames -	10	11
Product - -	854	8
Area of part before W, with the ſtem and gripe - -	8	10¾
Sum - -	863	6¾
		2
Area of fourth water line from dead flat forward - -	1727	1½

Fifth Water Line afore Dead Flat.

	Ft.	In.
Breadth at frame dead flat is 17 feet 2 inches—half	8	7
frame E - -	16	9
frame I - -	14	10
frame N - -	10	9½
frame Q is 5 feet—half -	2	6
Sum - -	53	5½
Diſtance between the frames -	10	11
Product - -	583	7
Area of part afore Q ſtem and knee - -	26	2½
	5	11½
Sum - - -	615	9
		2
Area of the fifth or lower water line from dead flat forward - -	1231	6
Area of the upper ſide of the keel -	87	4
Sum - - - -	1318	10
Half - -	659	5
Diſtance between the lower water line and keel - -	4	1
Content of the part contained between the lower water line and the keel in cub. feet	2692	7¼
Half the area of the load water line	1343	9
Area of the ſecond water line -	2435	0
third water line -	2115	4
fourth water line -	1727	1½
Half the area of the fifth or lower water line	615	9
Sum - - - -	8236	11½
Diſtance between the water lines -	4	1

	Ft.	In.
Cubic feet contained between the lower and load water lines -	33634	2¾
Cubic feet contained between lower water line and keel - -	2692	7½
Content of the keel and falſe keel -	196	6
Content afore midſhip frame under water when loaded - -	36523	4
Content abaft midſhip frame -	74050	6
Content under water - -	110573	10
Weight of a cubic foot of ſalt water	74 lbs.	
Weight of the whole ſhip with every thing on board - -	8182463.8 lbs.	

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As the weight of the ſhip, with every thing on board, found by this calculation, is equal to that found by eſtimate; it hence appears that the water line is properly placed in the draught. It now only remains to find whether the body is conſtructed ſuitably thereto, that is, whether the ſhip will be in her natural poſition when brought down to that line. For this purpoſe a perpendicular muſt be erected 27 feet ¼ inch. abaft dead flat, which will be the middle between the two perpendiculars and the place where the centre of gravity ſhould fall, that the ſhip may ſwim on an even keel. The ſolidity of that part of the bottom contained between the ſaid perpendicular and dead flat is then to be calculated, which will be found to be 25846 feet 7 inches.

Solidity of the bottom afore dead flat	36523 f.	4 in.
—— between the middle and dead flat	25846	7
Solid content of the fore part of the bottom - -	62369	11
Solidity of the bottom abaft dead flat	74050	6
—— between the middle and deadflat	25846	7
Solid content of the aft part of the bot.	48203	11
—— fore part of the bottom	62369	11
Difference - -	14166	
Half - -	7083	

Hence the after part of the ſhip's bottom is too lean by 7083 cubic feet, and the fore part as much too full. The after part muſt therefore be filled out until it has received an addition of 7083 feet, and the fore part muſt be drawn in till it has loſt the ſame quantity, and the bottom will then be conſtructed ſuitable to the ſhip's ſwimming on an even keel.

Chap. IX. *Of the Tonnage of a Ship.*

55 Proper method of calculating the tonnage of a ſhip.

This is a queſtion of equal importance and difficulty. By the tonnage of a ſhip is meant the weight of every thing that can with ſafety and expediency be taken on board that ſhip for the purpoſe of conveyance: it is alſo called the *ſhip's burthen*; and it is totally different from the weight of the whole as ſhe floats in the water. It is perhaps beſt expreſſed by calling it the *weight of the cargo*. It is of importance, becauſe it is by this that the merchant or freighter judges of the fitneſs of

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of the ſhip for his purpoſe. By this government judge of the ſhips requiſite for tranſport ſervice, and by this are all revenue charges on the ſhip computed. It is no leſs difficult to anſwer this queſtion by any general rule which ſhall be very exact, becauſe it depends not only on the cubical dimenſions of the ſhip's bottom, but alſo on the ſcantling of her whole frame, and in ſhort on the weight of every thing which properly makes part of a ſhip ready to receive on board her cargo. The weight of timber is variable; the ſcantling of the frame is no leſs ſo. We muſt therefore be contented with an average value which is not very remote from the truth; and this average is to be obtained, not by any mathematical diſcuſſion, but by obſervation of the burthen or cargo actually received, in a great variety of caſes. But ſome ſort of rule of calculation muſt be made out. This is and muſt be done by perſons not mathematicians. We may therefore expect to find it incapable of being reduced to any principle, and that every builder will have a different rule. Accordingly the rules given for this purpoſe are in general very whimſical, meaſures being uſed and combined in a way that ſeems quite unconnected with ſtercometry or the meaſurement of ſolids. The rules for calculation are even affected by the intereſts of the two parties oppoſitely concerned in the reſult. The calculation for the tonnage by which the cuſtoms are to be exacted by government are quite different from the rule by which the tonnage of a tranſport hired by government is computed; and the ſame ſhip hired as a tranſport will be computed near one half bigger than when paying importation duties.

Yet the whole of this might be made a very ſimple buſineſs and very exact. When the ſhip is launched, let her light-water line be marked, and this with the cubical contents of the immerſed part be noted down, and be engroſſed in the deed by which the property of the ſhip is conveyed from hand to hand. The weight of her maſts, ſails, rigging, and ſea-ſtores, is moſt eaſily obtained; and every builder can compute the cubical contents of the body when immerſed to the load-water line. The difference of theſe is unqueſtionably the burthen of the ſhip.

It is evident from what has been already ſaid in the laſt chapter, that if the number of cubic feet of water which the ſhip diſplaces when light, or, which is the ſame, the number of cubic feet below the light water line, found by the preceding method of calculation, be ſubtracted from the number of cubic feet contained in the bottom below the load water line, and the remainder reduced to tons by multiplying by 74, the number of pounds in a cubic foot of ſea water, and divided by 2240, the number of pounds in a ton, the quotient will be the tonnage.

But as this method is very troubleſome, the following rule for this purpoſe is that which is uſed in the king's and merchant's ſervice.

56 Common rule.

Let fall a perpendicular from the foreſide of the ſtem at the height of the hawſe holes (H), and another perpendicular from the back of the main poſt at the height of the wing tranſom. From the length between theſe two perpendiculars deduct three-fifths of the extreme breadth (1), and alſo as many times $2\frac{1}{2}$ inches as there are feet in the height of the wing tranſom above the upper edge of the keel; the remainder is the length of the keel for tonnage. Now multiply this length by the extreme breadth, and the product by half the extreme breadth, and this laſt product divided by 94 is the tonnage required.

Tonnage of a Ship.

Or, multiply the length of the keel for tonnage by the ſquare of the extreme breadth, and the product divided by 188 will give the tonnage.

Calculation of the Tonnage of an Eighty Gun Ship.

I. According to the true method.

57 Calculation of the tonnage of the eighty gun ſhip.

	tons	lbs
The weight of the ſhip at her launching draught of water	1593	406
The weight of the furniture -	195	720
The weight of the ſhip at her light water mark - -	1788	1126
The weight of the ſhip at the load water mark	3652	1983
Real burthen -	1864	857

II. By the common rule.

	Ft	inch.		
Length from the foreſide of the ſtem at the height of the hawſe holes, to the aft ſide of the main poſt, at the height of the wing tranſom -			185	10
Three-fifths of the extreme breadth is - -	29 f.	9½ in.		
Height of the wing tranſom is 28 f. 4 in. which multiplied by $2\frac{1}{2}$ inches is	6	8½		
Sum	36	6	36	6
Length of the keel for tonnage			149	4
Extreme breadth - -			49	8
Product - -			7416	10½
Half the extreme breadth -			24	10
94) 184185				8¾
Burthen according to the common rule - -			1959	929
Real burthen -			1864	857
Difference - -			95	72

58 The common rule gives the tonnage of ſhips of war greater, and of merchant ſhips leſs, than the truth.

Hence an eighty gun ſhip will not carry the tonnage ſhe is rated at by about 95 tons. As the body of this ſhip is fuller than in ſhips of war in general, there is therefore a nearer agreement between the tonnages found by the two different methods. It may be obſerved that ſhips of war carry leſs tonnage than they are rated at by the common rule, and that moſt merchants ſhips carry a

(H) In the merchant ſervice this perpendicular is let fall from the fore ſide of the ſtem at the height of the wing tranſom, by reaſon of the hawſe-holes being generally ſo very high in merchant ſhips, and their ſtems alſo having a great rake forward.

(1) The breadth underſtood in this place is the breadth from outſide to outſide of the plank.

Tonnage of a Ship.

a great deal more. In confirmation of this, it is thought proper to ſubjoin the dimenſions of ſeveral ſhips, with the tonnage calculated therefrom.

1. *Audacious of ſeventy four guns.*

Length on the gun deck		168 f.	0 in.
Length of the keel for tonnage		138	0
Extreme breadth		46	9
Depth of the hold		19	9
Launching draught of water	afore	12	0
	abaft	17	4
Load draught of water	afore	20	6
	abaft	21	6
The weight of the ſhip at her launching draught of water		1509 t.	678lbs.
The weight of the furniture		120	1500
Weight of the ſhip at her light water mark		1629	2178
Weight of the ſhip at her load water mark		2776	498
Real burthen		1146	560

By the common rule.

Length of the keel for tonnage	138 f.	0 in.
Extreme breadth	46	9
Product	6451	6
Half the extreme breadth	23	4½
	94)150803	
Tonnage according to the common rule	1604	643
Real burthen	1146	560
Difference	458	83

2. *An Eaſt Indiaman.*

Length between the perpendiculars forward and aft		132 f.	8 in.
Length of the keel for tonnage		105	0
Extreme breadth		38	0
Depth in hold		16	0
Launching draught of water	afore	7	10
	abaft	11	10
Load draught of water	afore	19	8
	abaft	20	8
The weight of the ſhip at her launching draught of water		602 t.	2116lbs.
The weight of the furniture		50	124
Weight of the ſhip at her light water mark		653	
Weight of the ſhip at her load water mark		1637	1670
Real burthen		984	1670

By the common rule.

Keel for tonnage	105 f.	
Extreme breadth	38	
Product	3999	
Half extreme breadth	19	
	94)75810	
Tonnage	806	1096
Real tonnage	984	1670
Difference	178	574

3. *A Cutter.*

Length of the keel for tonnage		58 f.	0 in.
Extreme breadth		29	0
Launching draught of water	afore	5	10
	abaft	9	8
Load draught of water	afore	9	0
	abaft	12	0
The weight of the cutter at her launching		147 t.	640lbs.
Weight of the furniture		9	199
Weight of the cutter at her light water mark		156	839
Weight of the cutter at her load water mark		266	1970
Real burthen		110	1131

By the common rule.

Keel for tonnage	58 f.
Extreme breadth	29
Product	1682
Half extreme breadth	14½
	94)24389
Tonnage by the common rule	259 1024
Real tonnage	110 1131
Difference	148 2133

The impropriety of the common rule is hence manifeſt, as there can be no dependence on it for aſcertaining the tonnage of veſſels.

We ſhall now ſubjoin the following experimental method of finding the tonnage of a ſhip.

59 Experimental method of determining the tonnage of veſſels.

Conſtruct a model agreeable to the draught of the propoſed ſhip, to a ſcale of about one-fourth of an inch to a foot, and let the light and load water lines be marked on it. Then put the model in water, and load it until the ſurface of the water is exactly at the light water line; and let it be ſuſpended until the water drains off, and then weighed. Now ſince the weights of ſimilar bodies are in the triplicate ratio of their homologous dimenſions, the weight of the ſhip when light is, therefore, equal to the product of the cube of the number of times the ſhip exceeds the model by the weight of the model, which is to be reduced to tons. Hence, if the model is conſtructed to a quarter of an inch ſcale, and its weight expreſſed in ounces; then to the conſtant logarithm 0.4893556, add the logarithm of the weight of the model in ounces, and the ſum will be the logarithm of the weight of the ſhip in tons.

Again, the model is to be loaded until the ſurface of the water coincides with the load water line. Now the model being weighed, the weight of the ſhip is to be found by the preceding rule: then the difference between the weights of the ſhip when light and loaded is the tonnage required.

Tonnage of a Ship.

It will alſo be worth while to add the following exact rule of Mr Parkins, who was many years foreman of the ſhipwrights in Chatham dockyard.

1. *For Men of War.*

Take the length of the gun-deck from the rabbet of the ſtem to the rabbet of the ſtern-poſt. $\frac{3}{4}\frac{1}{4}$ of this is to be aſſumed as the *length for tonnage*, = L.

Take the extreme breadth from outſide to outſide of the plank; add this to the length, and take $\frac{1}{11}$ of the ſum; call this the *depth for tonnage*, = D.

Set up this height from the limber ſtrake, and at that height take a breadth alſo from outſide to outſide of plank in the timber when the extreme breadth is found, and another breadth in the middle between that and the limber ſtrake; add together the extreme breadth and theſe two breadths, and take $\frac{1}{3}$ of the ſum for the breadth for tonnage, = D.

Multiply L, D, and B together, and divide by 49. The quotient is the burthen in tons.

The following proof may be given of the accuracy of this rule. Column 1. is the tonnage or burthen by the king's meaſurement; col. 2. is the tonnage by this rule; and, col. 3. is the weight actually received on board theſe ſhips at Blackſtakes:

Victory	100 guns.	2162	1839	1840
London	90	1845	1575	1677
Arrogant	74	1614	1308	1314
Diadem	64	1369	1141	965
Adamant	50	1044	870	886
Dolphin	44	879	737	758
Amphion	32	667	554	549
Daphne	20	429	329	374

2. *For Ships of Burthen.*

Take the length of the lower deck from the rabbet of the ſtem to the rabbet of the ſtern-poſt; then $\frac{1}{11}$ of this is the length for tonnage, = L.

Add the length of the lower deck to the extreme breadth from outſide to outſide of plank; and take $\frac{3}{5}\frac{1}{5}$ of the ſum for the depth for tonnage, = D.

Set up that depth from the limber ſtrake, and at this height take a breadth from outſide to outſide. Take another at $\frac{2}{3}$ of this height, and another at $\frac{1}{3}$ of the height. Add the extreme breadth and theſe three breadths, and take the 4th of the ſum for the breadth for tonnage, = B.

Multiply L, D, and B, and divide by $36\frac{1}{3}$. The quotient is the burthen in tons.

This rule reſts on the authority of many ſuch trials, as the following:

	King's Meaſm.	Rule.	Actually rec^{d}. on b^{d}.
Northington Indiaman	676	1053	1064
Granby Indiaman	786	1179	1179
Union coallier	193	266	289
Another coallier	182	254	277

Chap. X. *Of the Scale of Solidity.*

By this ſcale the quantity of water diſplaced by the bottom of the ſhip, for which it is conſtructed, anſwering to a given draught of water is eaſily obtained; and alſo the additional weight neceſſary to bring her down to the load water line.

Scale of Solidity.

In order to conſtruct this ſcale for a given ſhip, it is neceſſary to calculate the quantity of water diſplaced by the keel, and by that part of the bottom below each water line in the draught. Since the areas of the ſeveral water lines are already computed for the eighty gun ſhip laid down in Plates CCCCLX. and CCCCLXI. the contents of theſe parts may hence be eaſily found for that ſhip, and are as follow.

Draught of water.		Water diſplaced in Cubic feet.	Water diſplaced in tons. lbs.
Keel and falſe keel	2 f. 3 in.	660.9	21 1855
Diſt. bet. keel and 5th w. line	4 1	8583.1$\frac{1}{4}$	283 1233
Sum	6 4	9243.10$\frac{1}{4}$	305 848
Diſt. 5th and 4th w. line	4 1	18657.8$\frac{11}{48}$	616 828
Sum	10 5	27901.7$\frac{47}{48}$	921 1676
Diſt. 4th and 3d w. line	4 1	23574.6$\frac{17}{48}$	778 1795
Sum	14 6	51476.2$\frac{1}{4}$	1700 1231
Diſt. 3d and 2d w. line	4 1	27812.1$\frac{3}{14}$	918 1775
Sum	18 7	79288.3$\frac{11}{14}$	2619 766
Diſt. 2d and 1ſt w. line	4 1	31285.7$\frac{19}{14}$	1033 1218
Sum	22 8	110573.11$\frac{1}{4}$	3652 1984

Conſtruct any convenient ſcale of equal parts to repreſent tons, as ſcale n° 1. and another to repreſent feet, as n° 2.

Plate CCCCLXII. 60 Conſtruction of the ſcale of ſolidity for the ſhip of eighty guns.

Draw the line AB (fig. 36) limited at A, but produced indefinitely towards B. Make AC equal to the depth of the keel, 2 feet 3 inches from ſcale n° 2, and through C draw a line parallel to AB, which will repreſent the upper edge of the keel; upon which ſet off C*c* equal to 21 tons 1855 lbs, taken from ſcale n° 1. Again, make AD equal to the diſtance between the lower edge of the keel and the fifth water line, namely, 6 feet 4 inches, and a line drawn through D parallel to AB will be the repreſentation of the lower water line; and make D*b* equal to 305 tons 848 lbs, the correſponding tonnage. In like manner draw the other water lines, and lay off the correſponding tonnages accordingly: then through the points A, *c*, *b*, *e*, *f*, *g*, *h*, draw the curve A*cbefgh*. Through *h* draw *h*B perpendicular to AB, and it will be the greateſt limit of the quantity of water expreſſed in tons diſplaced by the bottom of the ſhip, or that when ſhe is brought down to the load water line. And ſince the ſhip diſplaces 1788 tons at her light water mark, take therefore that quantity from the ſcale n° 1, which being laid upon AB from A to K, and KL drawn perpendicular to AB, will be the repreſentation of the light water line for tonnage. Hence the ſcale will be completed.

Let

Scale of Solidity.

61 Use of the above scale.

Let it now be required to find the number of cubic feet displaced when the draught of water is 17 feet, and the number of additional tons necessary to bring her down to the load water mark.

Take the given draught of water 17 feet from the scale n° 2, which laid from it will reach to I; through which draw the line IMN parallel to AB, and intersecting the curve in AC; then the distance IM applied to the scale n° 1. will measure about 2248 tons, the displacement answerable to that draught of water; and MN applied to the same scale will measure about 1405 tons, the additional weight necessary to bring her down to the load water mark. Also the nearest distance between M and the line KL will measure about 460 tons, the weight already on board.

It will conduce very much to facilitate this operation to divide KB into a scale of tons taken from the scale n° 1, beginning at B, and also *b* L, beginning at *b*. Then when the draught of water is taken from the scale n° 2, and laid from it to I, as in the former example, and IMN drawn parallel to AB, and intersecting the curve in M. Now through M draw a line perpendicular to AB, and it will meet KB in a point representing the number of tons aboard, and also *b* L in a point denoting the additional weight necessary to load her.

Again, if the weight on board be given, the corresponding draught of water is obtained as follows.

Find the given number of tons in the scale KB, through which draw a line perpendicular to AB; then through the point of intersection of this line with the curve draw another line parallel to AB. Now the distance between A and the point where the parallel intersected AH being applied to the scale n° 2, will give the draught of water required.

Any other case to which this scale may be applied will be obvious.

Book II. *Containing the Properties of Ships*, &c.

Chap. I. *Of the Equilibrium of Ships.*

See *Hydrostatics.*

Since the pressure of fluids is equal in every direction, the bottom of a ship is therefore acted upon by the fluid in which it is immersed; which pressure, for any given portion of surface, is equal to the product of that portion by the depth and density of the fluid: or it is equal to the weight of a column of the fluid whose base is the given surface, and the altitude equal to the distance between the surface of the fluid and the centre of gravity of the surface pressed. Hence a floating body is in equilibrio between two forces, namely, its gravity and the vertical pressure of the fluid; the horizontal pressure being destroyed.

Plate CCCCLXIV.

Let ABC (fig. 49.) be any body immersed in a fluid whose line of floatation is GH: hence the pressure of the fluid is exerted on every portion of the surface of the immersed part AFCH. Let EF, CD be any two small portions contained between the lines ED, FC, parallel to each other, and to the line of floatation GH: then the pressure exerted upon EF is expressed by EF × IK, IK being the depth of EF or CD; the density of the fluid being supposed equal to 1. In like manner the pressure upon CD is equal to CD × IK. Now since the pressure is in a direction perpendicular to the surface, draw therefore the line EL perpendicular to EF, and DM perpendicular to DC, and make each equal to the depth IK, below the surface. Now the effort or pressure of the fluid upon EF will be expressed by EF × EL, and that upon CD by CD × DM. Complete the parallelograms ON, QS, and the pressure in the direction EL is resolved into EN, EO, the first in a horizontal, and the second in a vertical direction. In like manner, the pressure in the direction DM is resolved into the pressures DS, DQ. Hence the joint effect of the pressures in the horizontal and vertical directions, namely, EF × EN, and EF × EO, will be equal to EF × EL: For the same reason, CD × DP + CD × DQ = CD × DM. But the parts of the pressures in a horizontal direction EF × EN, and CD × DP, are equal. For, because of the similar triangles ENL, ERF, and DPM, DSC, we have $\frac{EL}{EN} = \frac{EF}{FR}$ and $\frac{DM}{DP} = \frac{DC}{CS}$: Hence DM × CS = DP × DC, and EL × FR = EN × EF. Now since EL = DM, and FR = CS, therefore EL × FR = DM × CS = DP × DC = EN × EF. Hence, since EF × EN = DP × CD, the effects of the pressures in a horizontal direction are therefore equal and contrary, and consequently destroy each other.

The pressure in a vertical direction is represented by EO × EF, DQ × DC, &c. which, because of the similar triangles EOL, ERF, and DLM, DSC, become EL × ER, DM × DS, &c. or IK × ER, IK × DS, &c. By applying the same reasoning to every other portion of the surface of the immersed part of the body, it is hence evident that the sum of the vertical pressures is equal to the sum of the corresponding displaced columns of the fluid.

Equilibrium of Ships.

62 The weight of a ship equal to that of the quantity of water displaced.

Hence a floating body is pressed upwards by a force equal to the weight of the quantity of water displaced; and since there is an equilibrium between this force and the weight of the body, therefore the weight of a floating body is equal to the weight of the displaced fluid (x). Hence also the centre of gravity of the body and the centre of gravity of the displaced fluid are in the same vertical, otherwise the body would not be at rest.

63 And the centre of gravity of both are in the same vertical.

Chap. II. *Upon the Efforts of the Water to bend a Vessel.*

Théorie complette, &c par Euler, translated by Watson.

When it is said that the pressure of the water upon the immersed part of a vessel counterbalances its weight, it is supposed that the different parts of the vessel are so closely connected together, that the forces which act upon its surface are not capable of producing any change. For we may easily conceive, if the connection of the parts were not sufficiently strong, the vessel would run the risk either of being broken in pieces, or of suffering some alteration in its figure.

The vessel is in a situation similar to that of a rod AB (fig. 50.), which being acted upon by the forces A *a*, C *c*, D *d*, B *b*, may be maintained in equilibrio,

(x) Upon this principle the weight and tonnage of the 80 gun ship laid down was calculated.

Efforts of the Water to bend a Veſſel.

provided it has a ſufficient degree of ſtiffneſs: but as ſoon as it begins to give way, it is evident it muſt bend in a convex manner, ſince its middle would obey the forces C *c* and D *d*, while its extremities would be actually drawn downwards by the forces A *a* and B *b*.

The veſſel is generally found in ſuch a ſituation; and ſince ſimilar efforts continually act whilſt the veſſel is immerſed in the water, it happens but too often that the keel experiences the bad effect of a ſtrain. It is therefore very important to inquire into the true cauſe of this accident.

Plate CCCCLXV.

For this purpoſe, let us conceive the veſſel to be divided into two parts by a tranſverſe ſection through the vertical axis of the veſſel, in which both the centre of gravity G (fig. 51.) of the whole veſſel and that of the immerſed part are ſituated: ſo that one of them will repreſent the head part, and the other that of the ſtern, each of which will be conſidered ſeparately. Let *g* be the centre of gravity of the entire weight of the firſt, and *o* that of the immerſed part correſponding. In like manner, let γ be the centre of gravity of the whole after part, and ω that of its immediate portion.

Now it is plain, that the head will be acted upon by the two forces *g m* and *o n*, of which the firſt will preſs it down, and the latter puſh it up. In the ſame manner, the ſtern will be preſſed down by the force $\gamma\mu$, and puſhed up by the force $\omega\nu$. But theſe four forces will maintain themſelves in equilibrium, as well as the total forces reunited in the points G and O, which are equivalent to them; but whilſt neither the forces before nor thoſe behind fall in the ſame direction, the veſſel will evidently ſuſtain efforts tending to bend the keel upwards, if the two points $o\omega$ are nearer the middle than the two other forces *g m* and $\gamma\mu$. A contrary effect would happen if the points o and ω were more diſtant from the middle than the points *g* and γ.

64 The cauſe of a ſhip's hogging,

65 And ſagging.

But the firſt of theſe two cauſes uſually takes place almoſt in all veſſels, ſince they have a greater breadth towards the middle, and become more and more narrow towards the extremities; whilſt the weight of the veſſel is in proportion much more conſiderable towards the extremities than at the middle. From whence we ſee, that the greater this difference becomes, the more alſo will the veſſel be ſubject to the forces which tend to bend its keel upwards. It is therefore from thence that we muſt judge how much ſtrength it is neceſſary to give to this part of the veſſel, in order to avoid ſuch a conſequence.

If other circumſtances would permit either to load the veſſel more in the middle, or to give to the part immerſed a greater capacity towards the head and ſtern, ſuch an effect would no longer be apprehended. But the deſtination of moſt veſſels is entirely oppoſite to ſuch an arrangement: by which means we are obliged to ſtrengthen the keel as much as may be neceſſary, in order to avoid ſuch a diſaſter.

We ſhall conclude this chapter with the following practical obſervations on the hogging and ſagging of ſhips by Mr Hutchinſon of Liverpool:

Practical Seamanſhip, p. 13.

"When ſhips with long floors happen to be laid adry upon mud or ſand, which makes a ſolid reſiſtance againſt the long ſtraight floors amidſhips, in compariſon with the two ſharp ends, the entrance and run meet with little ſupport, but are preſſed down lower than the flat of the floor, and in proportion hogs the ſhip amidſhips; which is too well known from experience to occaſion many total loſſes, or do ſo much damage by hogging them, as to require a vaſt deal of trouble and expence to ſave and repair them, ſo as to get the hog taken out and brought to their proper ſheer again: and to do this the more effectually, the owners have often been induced to go to the expence of lengthening them; and by the common method, in proportion as they add to the burden of theſe ſhips, by lengthening their too long ſtraight floors in their main bodies amidſhips, ſo much do they add to their general weakneſs to bear hardſhips either on the ground or afloat; for the ſcantling of their old timber and plank is not proportionable to bear the additional burden that is added to them.

Efforts of the Water to bend a Veſſel.

"But defects of this kind are beſt proved from real and inconteſtable facts in common practice. At the very time I was writing upon this ſubject, I was called upon for my advice by the commander of one of thoſe ſtrong, long, ſtraight floored ſhips, who was in much trouble and diſtraction of mind for the damage his ſhip had taken by the pilot laying her on a hard, gentle ſloping ſand, at the outſide of our docks at Liverpool, where it is common for ſhips that will take the ground to lie for a tide, when it proves too late to get into our wet docks. After recommending a proper ſhip carpenter, I went to the ſhip, which lay with only a ſmall keel, yet was greatly hogged, and the butts of her upper works ſtrained greatly on the lee-ſide; and the ſeams of her bottom, at the lower futtock heads, vaſtly opened on the weather ſide: all which ſtrained parts were agreed upon not to be caulked, but filled with tallow, putty, or clay, &c. with raw bullocks hides, or canvas nailed with battons on her bottom, which prevented her ſinking with the flow of the tide, without hindering the preſſure of water from righting and cloſing the ſeams again as ſhe floated, ſo as to enable them to keep her free with pumping. This veſſel, like many other inſtances of ſhips of this conſtruction that I have known, was ſaved and repaired at a very great expence in our dry repairing docks. And that their bottoms not only hog upwards, but ſag (or curve) downwards, to dangerous and fatal degrees, according to the ſtrain or preſſure that prevails upon them, will be proved from the following facts:

"It has been long known from experience, that when ſhips load deep with very heavy cargoes or materials that are ſtowed too low, it makes them ſo very labourſome at ſea, when the waves run high, as to roll away their maſts; and after that misfortune cauſes them to labour and roll the more, ſo as to endanger their working and ſtraining themſelves to pieces: to prevent which, it has been long a common practice to leave a great part of their fore and after holds empty, and to ſtow them as high as poſſible in the main body at midſhips, which cauſes the bottoms of theſe long ſtraight floored ſhips to ſag downwards, in proportion as the weight of the cargo ſtowed there exceeds the preſſure of the water upwards, ſo much ſo as to make them dangerouſly and fatally leaky.

"I have known many inſtances of thoſe ſtrong ſhips of 500 or 600 tons burdens built with long ſtraight floors, on the eaſt coaſt of England, for the coal and timber trade, come loaded with timber from the Baltic

Efforts of the Water to bend a Veſſel.

to Liverpool, where they commonly load deep with rock ſalt, which is too heavy to fill their holds, ſo that for the above reaſons they ſtowed it high amidſhips, and left large empty ſpaces in their fore and after holds, which cauſed their long ſtraight floors to ſag downwards, ſo much as to make their hold ſtaunchions amidſhips, at the main hatchway, ſettle from the beams three or four inches, and their mainmaſts ſettle ſo much as to oblige them to ſet up the main rigging when rolling hard at ſea, to prevent the maſts being rolled away; and they were rendered ſo leaky as to be obliged to return to Liverpool to get their leaks ſtopped at great expence. And in order to ſave the time and expence in diſcharging them, endeavours were made to find out and ſtop their leaks, by laying them aſhore dry on a level ſand; but without effect: for though their bottoms were thus ſagged down by their cargoes when afloat, yet when they came a-dry upon the ſand, ſome of their bottoms hogged upwards ſo much as to raiſe their mainmaſts and pumps ſo high as to tear their coats from their decks; ſo that they have been obliged to diſcharge their cargoes, and give them a repair in the repairing dock, and in ſome to double their bottoms, to enable them to carry their cargoes with ſafety, ſtowed in this manner. From this cauſe I have known one of theſe ſtrong ſhips to founder.

"Among the many inſtances of ſhips that have been diſtreſſed by carrying cargoes of lead, one ſailed from hence bound to Marſeilles, which was ſoon obliged to put back again in great diſtreſs, having had four feet water in the hold, by the commander's account, owing to the ſhip's bottom ſagging down to ſuch a degree as made the hold ſtaunchions ſettle ſix inches from the lower deck beams amidſhips; yet it is common with theſe long ſtraight floored ſhips, when theſe heavy cargoes are diſcharged that makes their bottom ſag down, then to hog upwards: ſo that when they are put into a dry repairing dock, with empty holds, upon ſtraight blocks, they commonly either ſplit the blocks cloſe fore and aft, or damage their keels there, by the whole weight of the ſhip lying upon them, when none lies upon the blocks under the flat of their floors amidſhips, that being hogged upwards; which was the caſe of this ſhip's bottom; though ſagged downwards ſix inches by her cargo, it was now found hogged ſo much that her keel did not touch the blocks amidſhips, which occaſioned ſo much damage to the after part of the keel, as to oblige them to repair it; which is commonly the caſe with theſe ſhips, and therefore deſerving particular notice."

In order to prevent theſe defects in ſhips, "they ſhould all be built with their floors or bottoms lengthwiſe, to form an arch with the projecting part downwards, which will naturally not only contribute greatly to prevent their taking damage by their bottoms hogging and ſtraining upwards, either aground or afloat, as has been mentioned, but will, among other advantages, be a help to their ſailing, ſteering, ſtaying, and waring."

Chap. III. *Of the Stability of Ships.*

When a veſſel receives an impulſe or preſſure in a horizontal direction, ſo as to be inclined in a ſmall degree, the veſſel will then either regain its former poſition as the preſſure is taken off, and is in this caſe ſaid to be poſſeſſed of ſtability; or it will continue in its inclined ſtate; or, laſtly, the inclination will increaſe until the veſſel is overturned. With regard to the firſt caſe, it is evident that a ſufficient degree of ſtability is neceſſary in order to ſuſtain the efforts of the wind; but neither of the other two caſes muſt be permitted to have place in veſſels.

Stability of Ships.

Let CED (fig. 52.) be the ſection of a ſhip paſſing through its centre of gravity, and perpendicular to the ſheer and floor plans; which let be in equilibrium in a fluid; AB being the water line, G the centre of gravity of the whole body, and *g* that of the immerſed part AEB. Let the body receive now a very ſmall inclination, ſo that *a* E *b* becomes the immerſed part, and γ its centre of gravity. From γ draw γ M perpendicular to *a b*, and meeting *g* G, produced, if neceſſary, in M. If, then, the point M thus found is higher than G the centre of gravity of the whole body, the body will, in this caſe, return to its former poſition, the preſſure being taken off. If the point M coincides with G, the veſſel will remain in its inclined ſtate; but if M be below G, the inclination of the veſſel will continually increaſe until it is entirely overſet.

The point of interſection M is called the *metacenter*, and is the limit of the altitude of the centre of gravity of the whole veſſel. Whence it is evident, from what has already been ſaid, that the ſtability of the veſſel increaſes with the altitude of the metacenter above the centre of gravity: But when the metacenter coincides with the centre of gravity, the veſſel has no tendency whatever to move out of the ſituation into which it may be put. Thus, if the veſſel be inclined either to the right or left ſide, it will remain in that poſition until a new force is impreſſed upon it: in this caſe, therefore, the veſſel would not be able to carry ſail, and is hence unfit for the purpoſes of navigation. If the metacenter is below the common centre of gravity, the veſſel will inſtantly overſet.

As the determination of the metacenter is of the utmoſt importance in the conſtruction of ſhips, it is therefore thought neceſſary to illuſtrate this ſubject more particularly.

Let AEB (fig. 52.) be a ſection of a ſhip perpendicular to the keel, and alſo to the plane of elevation, and paſſing through the centre of gravity of the ſhip, and alſo through the centre of gravity of the immerſed part, which let be *g*.

Now let the ſhip be ſuppoſed to receive a very ſmall inclination, ſo that the line of floatation is *a*, *b*, and γ the centre of gravity of the immerſed part *a* E *b*. From γ draw γ M perpendicular to *a b*, and interſecting GM in M, the metacenter, as before. Hence the preſſure of the water will be in the direction γ M.

In order to determine the point M, the metacenter, the poſition of γ with reſpect to the lines AB and *g* G, muſt be previouſly aſcertained. For this purpoſe, let the ſhip be ſuppoſed to be divided into a great number of ſections by planes perpendicular to the keel, and parallel to each other, and to that formerly drawn, theſe planes being ſuppoſed equidiſtant. Let AEB (fig. 53.) be one of theſe ſections, *g* the centre of gravity of the immerſed part before inclination, and γ the centre of gravity of the immerſed part when the ſhip is in its inclined ſtate; the diſtance *g* γ between the two centres of

Stability of Ships.

of gravity in each ſection is to be found. Let AB be the line of floatation of the ſhip when in an upright ſtate, and *a b* the water line when inclined. Then, becauſe the weight of the ſhip remains the ſame, the quantity of water diſplaced will alſo be the ſame in both caſes, and therefore AEB = *a* E *b*, each ſuſtaining the ſame part of the whole weight of the ſhip. From each of theſe take the part AE *b*, which is common to both, and the remainders AO *a*, BO *b* will be equal; and which, becauſe the inclination is ſuppoſed very ſmall, may be conſidered as rectilineal triangles, and the point O the middle of AB.

Now, let H, I, K, be the centres of gravity of the ſpaces AO *a*, AE *b*, and BO *b*, reſpectively. From theſe points draw the lines H *b*, I *i*, and K *k*, perpendicular to AB, and let IL be drawn perpendicular to EO. Now to aſcertain the diſtance γq of the centre of gravity γ of the part *a* E *b* from the line AB, the momentum of *a* E *b* with reſpect to this line muſt be put equal to the difference of the momentums of the parts AE *b*, AO *a*, which are upon different ſides of AB †. Hence *a* E *b* × γq, or AEB × γq = AE *b* × I *i* — AO *a* × H *b*. But ſince *g* is the common centre of gravity of the two parts AE*b*, BO *b*, we have therefore AEB × *g* O = AE *b* × I *i* + BO *b* × K *k*. Hence by expunging the term AE *b* × I *i* from each of theſe equations, and comparing them, we obtain AEB × γq = AEB × *g* O — BO *b* × K *k* — AO *a* × H *b*.

† *Bezout's Mechanique*, art. 263.

Now, ſince the triangles AO *a*, BO *b*, are ſuppoſed infinitely ſmall, their momentums or products, by the infinitely little lines H *b*, K *k*, will alſo be infinitely ſmall with reſpect to AEB × *g* O; which therefore being rejected, the former equation becomes AEB × γq = AEB × *g* O, and hence γq = *g* O. Whence the centres of gravity γ, *g*, being at equal diſtances below AB, the infinitely little line γg is therefore perpendicular to EO. For the ſame reaſon $g\gamma$, fig. 52. may be conſidered as an arch of a circle whoſe centre is M.

To determine the value of $g\gamma$, the momentum of *a* E *b* with reſpect to EO muſt be taken, for the ſame reaſon as before, and put equal to the momentums of the two parts AO *a*, AE *b*; and we ſhall then have *a* E *b* × *g* γ, or AEB × *g* γ = AEB × IL + AO *a* × O *b*. But ſince *g* is the common centre of gravity of the two ſpaces AE *b*, BO *b*, we ſhall have AE *b* × IL — BO *b* × O *k* = O, or AE *b* × IL = BO *b* × O *k*. Hence AEB × *g* γ = BO *b* × O *k* + AO *a* × O *b* = 2 BO *b* × O *k*; becauſe the two triangles AO *a*, BO *b* are equal, and that the diſtances O *k*, O *b*, are alſo evidently equal.

Let *x* be the thickneſs of the ſection repreſented by ABC. Then the momentum of this ſection will be 2 BO *b* × *x* × O *k*, which equation will alſo ſerve for each particular ſection.

Now let $\int$ repreſent the ſum of the momentums of all the ſections. Hence $\int$, AEB × *x* × *g* γ = $\int$, 2. BO *b* × *x* × O *k*. Now the firſt member being the ſum of the momentums of each ſection, in proportion to a plane paſſing through the keel, ought therefore to be equal to the ſum of all the ſections, or to the volume of the immerſed part of the bottom multiplied by the diſtance $g\gamma$. Hence V repreſenting the volume, we ſhall have V × *g* γ = $\int$, 2 BO *b* × *x* O *k*.

In order to determine the value of the ſecond member of this equation, it may be remarked, that when the ſhip is inclined, the original plane of floatation CBPQ (fig. 54.) becomes C *b p* Q. Now the triangles NI *n*, BO *b*, being the ſame as thoſe in figures 52. and 53.; and as each of theſe triangles have one angle equal, they may, upon account of their infinite ſmallneſs, be conſidered as ſimilar; and hence BO *b* : NI *n* :: $\overline{OB}|^2$: $\overline{IN}|^2$; whence BO *b* = $\frac{\overline{OB}|^2}{\overline{IN}|^2}$ × NI *n*. Moreover, we have (fig. 53.) O *k* = $\frac{2}{3}$ OB, for the points K and *k* may be conſidered as equidiſtant from the point O: whence BO *b* × O *k* = $\frac{\frac{2}{3}\overline{OB}|}{\overline{IN}|^2}$ × NI *n*.

Hence V × *g* γ = $\int$, $\frac{\frac{2}{3}\overline{OB}|^3}{\overline{IN}|^2}$ × *x* × NI *n*. From this equation the value of $g\gamma$ is obtained.

To find the altitude *g* M (fig. 55.) of the metacenter above the centre of gravity of the immerſed part of the bottom, let the arc NS be deſcribed from the centre I with the radius IN; then NI *n* = $\frac{IN \times NS}{2}$. Now ſince the two ſtraight lines γ M, *g* M are perpendicular to *an* and AN reſpectively, the angles M and NI *n* are therefore equal: and the infinitely little portion $g\gamma$, which is perpendicular to *g* M, may be conſidered as an arch deſcribed from the centre M. Hence the two ſectors NIS, *g* M γ are ſimilar; and therefore *g* M : $g\gamma$ :: IN : NS. Hence NS = $\frac{IN \times g\gamma}{g\,M}$; and conſequently NI *n* = $\frac{\overline{IN}|^2 \times g\gamma}{2\,g\,M}$. Now this being ſubſtituted in the former equation, and reduced, we have V × *g* γ = $\int \frac{\frac{2}{3}\overline{OB}|^3 \times x \times g\gamma}{g\,M}$. But ſince *g* M and $g\gamma$ are the ſame, whatever ſection may be under conſideration, the equation may therefore be expreſſed thus, V × *g* γ = $\frac{\frac{2}{3}g\gamma}{g\,M} \cdot \int, \overline{OB}|^3 \times x$. Hence *g* M = $\frac{\frac{2}{3}\int, \overline{OB}|^3 \times x}{V}$. Let y = OB, and the equation becomes *g* M = $\frac{\frac{2}{3}\int, y^3 x}{V}$. Whence to have the altitude of the metacenter above the centre of gravity of the immerſed part of the bottom, the length of the ſection at the water-line muſt be divided by lines perpendicular to the middle line of this ſection into a great number of equal parts, ſo that the portion of the curve contained between any two adjacent perpendiculars may be conſidered as a ſtraight line. Then the ſum of the cubes of the half perpendiculars or ordinates is to be multiplied by the diſtance between the perpendiculars, and two thirds of the product is to be divided by the volume of the immerſed part of the bottom of the ſhip.

It is hence evident, that while the ſector at the water line is the ſame, and the volume of the immerſed part of the bottom remains alſo the ſame, the altitude of the metacenter will remain the ſame, whatever may be the figure of the bottom.

CHAP. IV. *Of the Centre of Gravity of the immerſed Part of the Bottom of a ſhip.*

THE centre of gravity * of a ſhip, ſuppoſed homogeneous, and in an upright poſition in the water, is in a ver-

* See *Mechanics*.

Centre of Gravity.

vertical section passing through the keel, and dividing the ship into two equal and similar parts, at a certain distance from the stern, and altitude above the keel.

In order to determine the centre of gravity of the immersed part of a ship's bottom, we must begin with determining the centre of gravity of a section of the ship parallel to the keel, as ANDFPB (fig. 56.), bounded by the parallel lines AB, DF, and by the equal and similar curves AND, BPF.

66 Distance of the centre of gravity from the stem or stern.

If the equation of this curve were known, its centre of gravity would be easily found: but as this is not the case, let therefore the line CE be drawn through the middle C, E, of the lines AB, DF, and let this line CE be divided into so great a number of equal parts by the perpendiculars TH, KM, &c. that the arches of the curves contained between the extremities of any two adjacent perpendiculars may be considered as straight lines. The momentums of the trapeziums DTHF, TKMH, &c. relative to the point E, are then to be found, and the sum of these momentums is to be divided by the sum of the trapeziums, that is, by the surface ANDFPB.

The distance of the centre of gravity of the trapezium THFD from the point E is $= \frac{\frac{1}{3}IE \times (DF+2TH)}{DF+TH}$ ‡.

‡ Bezout's Mechanique, art. 279.

For the same reason, and because of the equality of the lines IE, IL, the distance of the centre of gravity of the trapezium TKMH from the same point E will be $\frac{\frac{1}{3}IE \times (TH+2KM)}{TH+KM} + IE$, or $= \frac{\frac{1}{3}IE \times (4TH+5KM)}{TH+KM}$.

In like manner, the distance of the centre of gravity of the trapezium NKMP from the point E will be $\frac{\frac{1}{3}IE \times (KM+2NP)}{KM+NP} + 2IE$, or $\frac{\frac{1}{3}IE \times (7KM+8NP)}{KM+NP}$, &c.

Now, if each distance be multiplied by the surface of the corresponding trapezium, that is, by the product of half the sum of the two opposite sides of the trapezium into the common altitude IE, we shall have the momentums of these trapeziums, namely, $\frac{1}{6}\overline{IE}|^2 \times (DF+2TH)$, $\frac{1}{6}\overline{IE}|^2 \times (4TH+5KM)$ $\frac{1}{6}\overline{IE}|^2 \times (7KM+8NP)$, &c. Hence the sum of these momentums will be $\frac{1}{6}\overline{IE}|^2 \times (DF+6TH+12KM+18NP+24QS+14AB)$. Whence it may be remarked, that if the line CE be divided into a great number of equal parts, the factor or coefficient of the last term, which is here 14, will be $= 2+3(n-2)$ or $3n-4$, n being the number of perpendiculars. Thus the general expression of the sum of the momentums is reduced to $\overline{IE}|^2 \times (\frac{1}{6}DF + TH + 2KM + 3NP + 4QS +$, &c. $-+ \frac{3n-4}{6} \times AB)$.

The area of the figure ANDFPB is equal to $IE \times (\frac{1}{2}DF + TH + KM + NP +$, &c.... $+ \frac{1}{2}AB)$; hence the distance EG of the centre of gravity G from one of the extreme ordinates DF is equal to

$$\frac{IE \times (\frac{1}{6}DF+TH+2KM+3NP+, \&c. + \frac{3n-4}{6} \times AB)}{\frac{1}{2}DF+IH+KM+NP+, \&c. + \frac{1}{2}AB}.$$

67 Rule for the distance of the centre of gravity from one of the extreme ordinates.

Whence the following rule to find the distance of the centre of gravity G from one of the extreme ordinates DF. To the sixth of the first ordinate add the sixth of the last ordinate multiplied by three times the number of ordinates minus four; then the second ordinate, twice the third, three times the fourth, &c. the sum will be a first term. Then to half the sum of the extreme ordinates add all the intermediate ones, and the sum will be a second term. Now the first term divided by the second, and the quotient multiplied by the interval between two adjacent perpendiculars, will be the distance sought.

Centre of Gravity.

Thus, let there be seven perpendiculars, whose values are 18, 23, 28, 30, 30, 21, 0, feet respectively, and the common interval between these perpendiculars 20 feet. Now the sixth of the first term 18 is 3; and as the last term is 0, therefore to 3 add 23, twice 28 or 56, thrice 30 or 90, four times 30 or 120, five times 21 or 105; and the sum is 397. Then to the half of 18+0, or 9, add the intermediate ordinates, and the sum will be 141. Now $\frac{397 \times 20}{141}$, or $\frac{7940}{141}$, $= 59$ feet 4 inches nearly, the distance of the centre of gravity from the first ordinate.

Now, when the centre of gravity of any section is determined, it is easy from thence to find the centre of gravity of the solid, and consequently that of the bottom of a ship.

68 Height of the centre of gravity above the keel.

The next step is to find the height of the centre of gravity of the bottom above the keel. For this purpose the bottom must be imagined to be divided into sections by planes parallel to the keel or water-line, (figs. 57, 58.) Then the solidity of each portion contained between two parallel planes will be equal to half the sum of the two opposed surfaces multiplied by the distance between them; and its centre of gravity will be at the same altitude as that of the trapezium *a b c d*, (fig. 58.), which is in the vertical section passing through the keel. It is hence obvious, that the same rule as before is to be applied to find the altitude of the centre of gravity, with this difference only, that the word perpendicular or ordinate is to be changed into section. Hence the rule is, to the sixth part of the lowest section add the product of the sixth part of the uppermost section by three times the number of sections minus four; the second section in ascending twice the third, three times the fourth, &c. the sum will be a first term. To half the sum of upper and lower sections add the intermediate ones, the sum will be a second term. Divide the first term by the second, and the quotient multiplied by the distance between the sections will give the altitude of the centre of gravity above the keel.

With regard to the centre of gravity of a ship, whether it is considered as loaded or light, the operation becomes more difficult. The momentum of every different part of the ship and cargo must be found separately with respect to a horizontal and also a vertical plane. Now the sums of these two momentums being divided by the weight of the ship, will give the altitude of the centre of gravity, and its distance from the vertical plane; and as this centre is in a vertical plane passing through the axis of the keel, its place is therefore determined. In the calculation of the momentums, it must be observed to multiply the weight, and not the magnitude of each piece, by the distance of its centre of gravity.

A more easy method of finding the centre of gravity of a ship is by a mechanical operation, as follows: Construct

Centre of Gravity.

69 A mechanical method for aſcertaining the centre of gravity of a ſhip.

a block of as tight wood as poſſible, exactly ſimilar to the parts of the propoſed draught or ſhip, by a ſcale of about one-fourth of an inch to a foot. The block is then to be ſuſpended by a ſilk-thread or very fine line, placed in different ſituations until it is found to be in a ſtate of equilibrium, and the centre of gravity will be pointed out. The block may be proved by faſtening the line which ſuſpends it to any point in the line joining the middles of the ſtem and poſt, and weights are to be ſuſpended from the extremities of this middle line at the ſtem and poſt. If, then, the block be properly conſtructed, a plane paſſing through the line of ſuſpenſion, and the other two lines, will alſo paſs through the keel, ſtem, and poſt. Now, the block being ſuſpended in this manner from any point in the middle line, a line is to be drawn on the block parallel to the line of ſuſpenſion, ſo that the plane paſſing through theſe two lines may be perpendicular to the vertical plane of the ſhip in the direction of the keel. The line by which the block is ſuſpended is then to be removed to ſome other convenient point in the middle line; and another line is to be drawn on the block parallel to the line ſuſpending it, as before. Then the point of interſection of this line with the former will give the poſition of the centre of gravity on the block, which may now be laid down in the draught.

Centre of Gravity.

CHAP. V. *Application of the preceding Rules to the Determination of the Centre of Gravity and the Height of the Metacenter above the Centre of Gravity of a Ship of 74 Guns.*

IN fig. 59. are laid down the ſeveral ſections in a horizontal direction, by planes parallel to the keel, and at equal diſtances from each other, each diſtance being 10 feet 0 inches 4 parts.

I. *Determination of the Centre of Gravity of the upper Horizontal Section.*

To find the diſtance of the centre of gravity of the plane 8 *g o* G from the firſt ordinate 8 *g*.

Ordinates. Feet.	In	P.	Double Ord. Feet.	In.	P.	1ſt Factors.	1ſt Products. Feet.	In.	P.	2d Factors.	2d Products. Feet.	In.	P.
14	9	0	29	6	0	$0\frac{1}{8}$	4	11	0	$0\frac{1}{2}$	14	9	0
17	1	6	34	3	0	1	34	3	0	1	34	3	0
18	9	0	37	6	0	2	75	0	0	1	37	6	0
19	10	0	39	8	0	3	119	0	0	1	39	8	0
20	7	6	41	3	0	4	165	0	0	1	41	3	0
21	1	9	42	3	6	5	211	5	6	1	42	3	6
21	6	3	43	0	6	6	258	3	0	1	43	0	6
21	7	9	43	3	6	7	303	0	6	1	43	3	6
21	7	9	43	3	6	8	346	4	0	1	43	3	6
21	7	6	43	3	0	9	389	3	0	1	43	3	0
21	4	0	42	8	0	10	426	8	0	1	42	8	0
20	10	6	41	9	0	11	459	3	0	1	41	9	0
19	9	0	39	6	0	12	474	0	0	1	39	6	0
17	4	6	34	9	0	13	451	9	0	1	34	9	0
13	1	3	26	2	6	$((3\times15)-4)\times\frac{1}{8}$	179	1	1	$0\frac{1}{2}$	13	1	3
291	1	3	582	2	6		3897	3	1		554	4	3

Now $\frac{3897\ 3\ 1}{554\ 4\ 3}\times 10\ 0\ 4 = \frac{3897\cdot25}{554\cdot25}\times 10.03 = 70.5$.

	Feet.
Hence the diſtance of the centre of gravity of double the plane 8 *g o* G from the firſt ordinate 8 *g*, is	70.5
Diſtance of this ordinate from the aft ſide of ſtern-poſt,	13.5
Diſtance of the centre of gravity from the aft ſide of poſt,	84.0
Diſtance of the centre of gravity of double the trapezium AR *g* 8 from its ordinate AR,	8.42
Diſtance of this ordinate from the aft ſide of the ſtern-poſt,	0.58
Diſtance of the centre of gravity of this plane from the aft ſide of the ſtern-poſt,	9.0
Diſtance of the centre of gravity of double the trapezium G *o* γ γ from its ordinate G *o*,	5.44
Diſtance of this ordinate from the aft ſide of the poſt,	153.78
Diſtance of the centre of gravity of this trapezium from the aft ſide of the poſt,	159.22
Diſtance of the centre of gravity of the ſection of the ſtern-poſt from the aft part of the poſt,	0.29
Diſtance of the centre of gravity of the ſection of the ſtern from the aft ſide of the poſt,	169.76

The

Fig. 35.

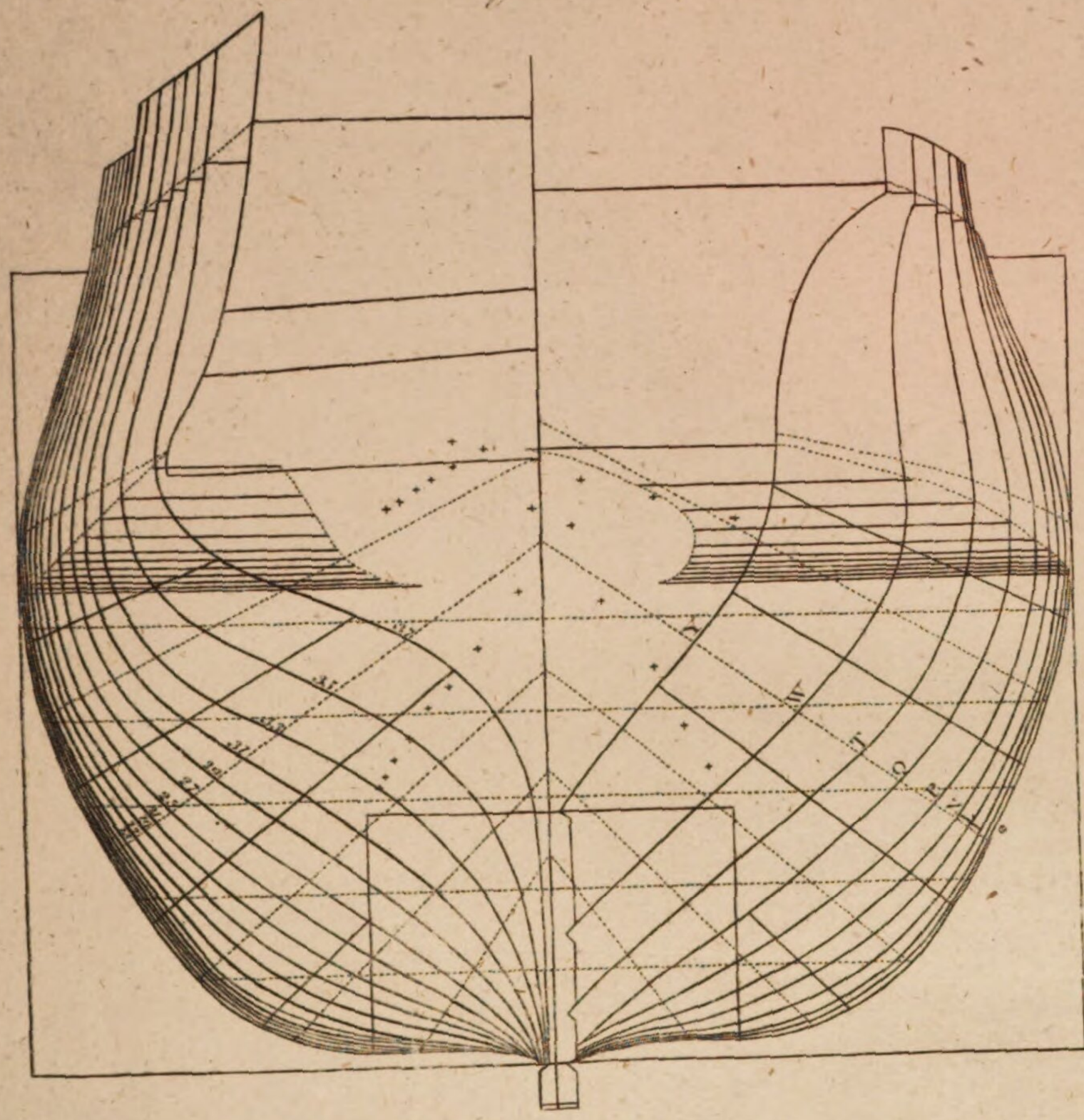
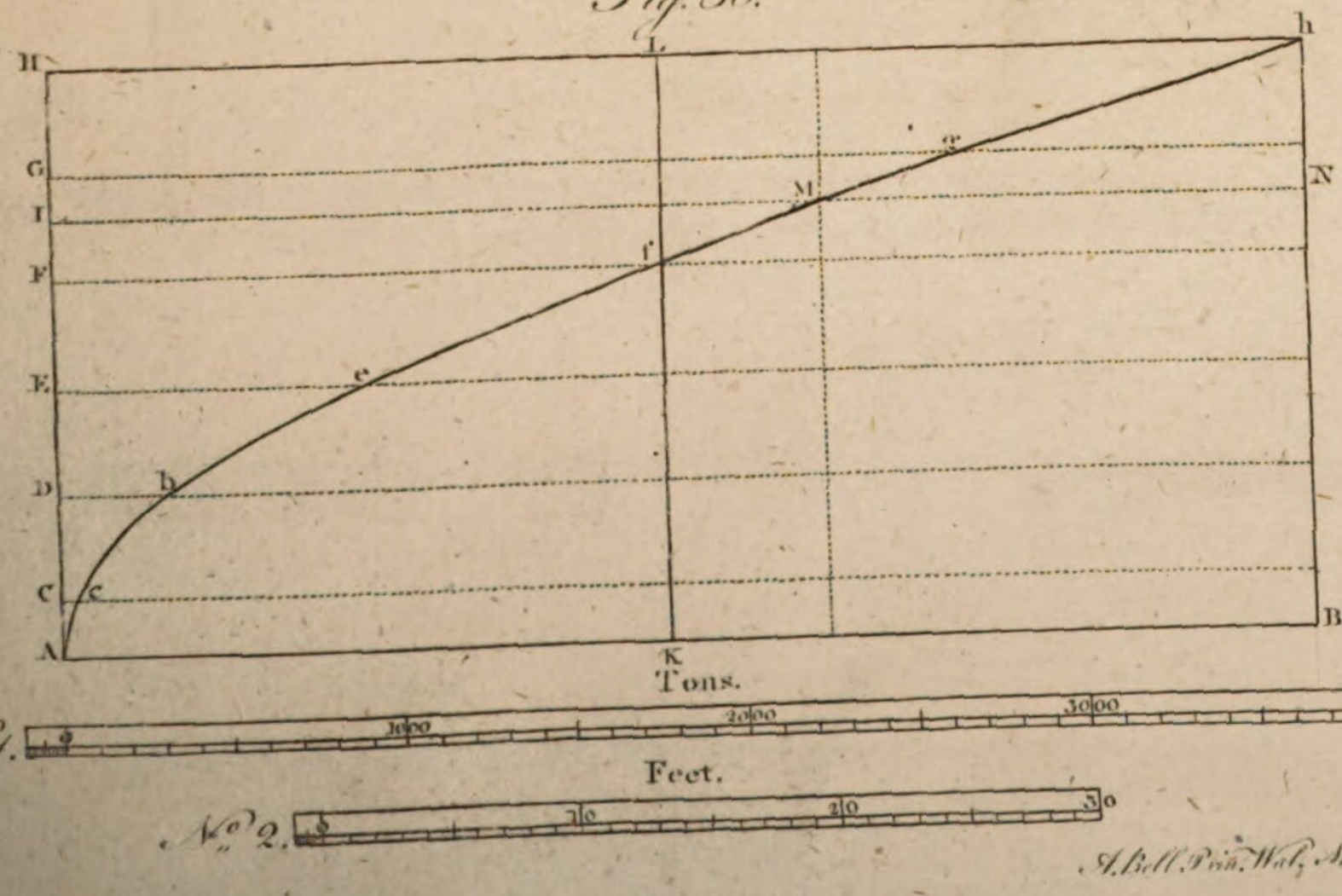


Fig. 36.



No 1.

No 2.

A. Bell. Pinx. Wal. Sculptor fecit.

Fig. 37.

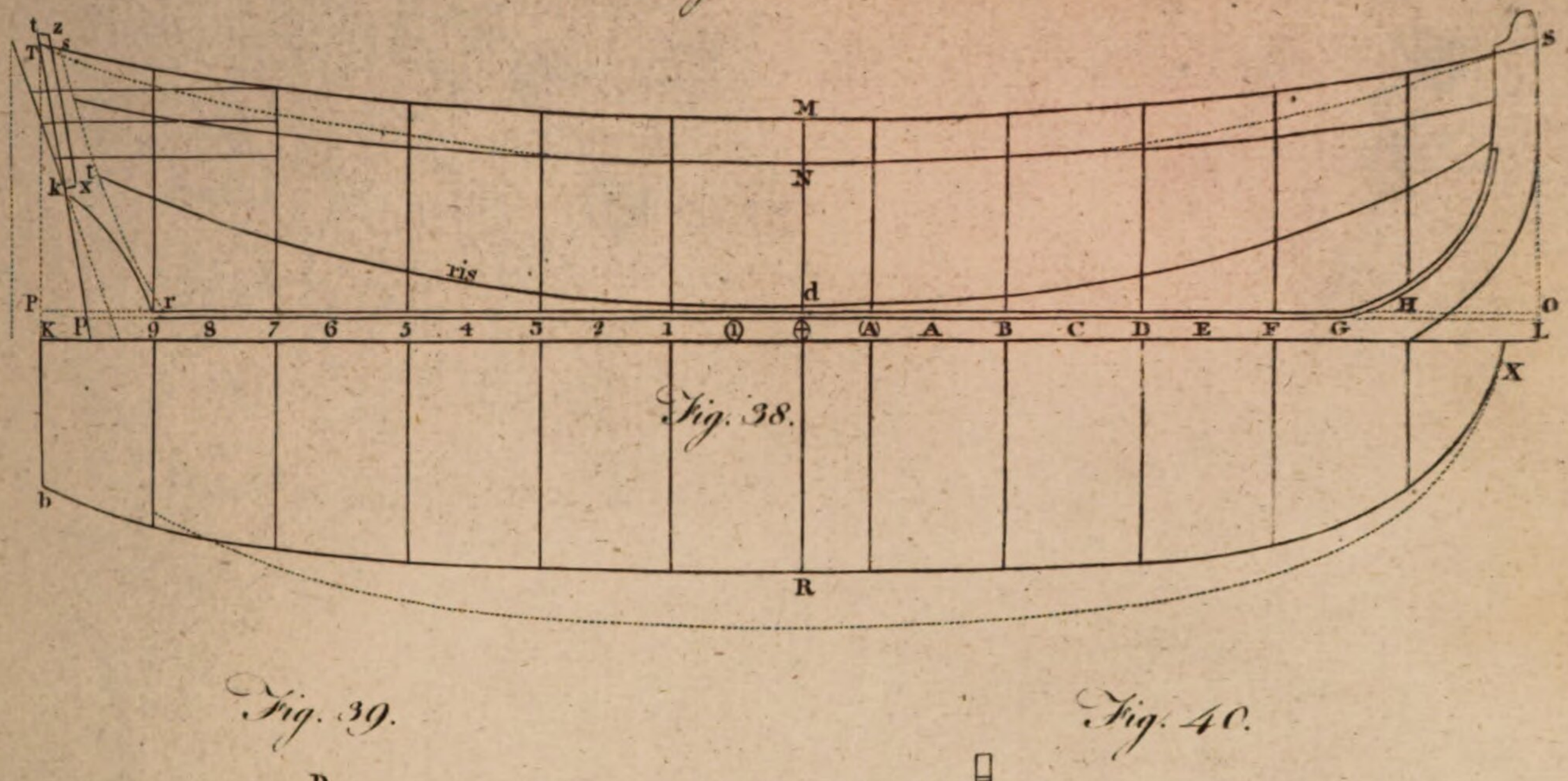
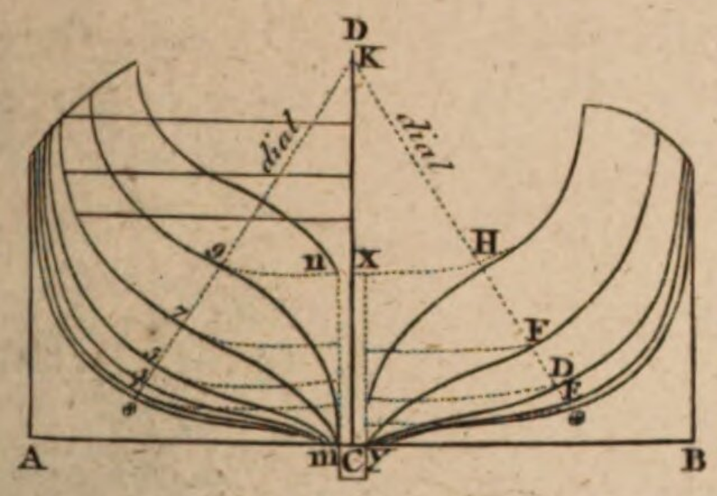


Fig. 38.

Fig. 39.



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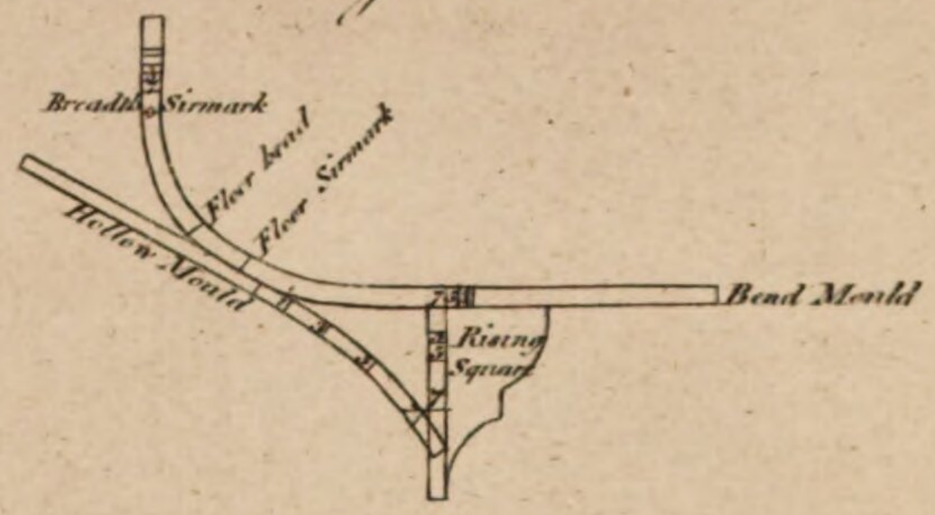
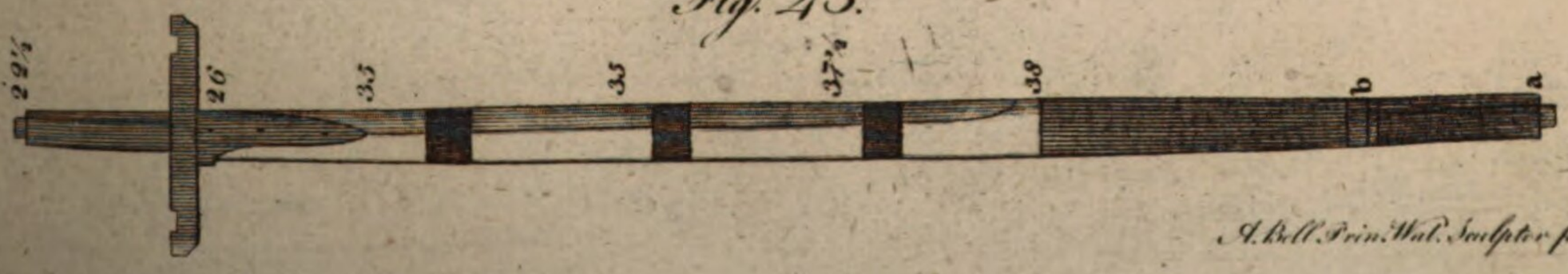


Fig. 41.

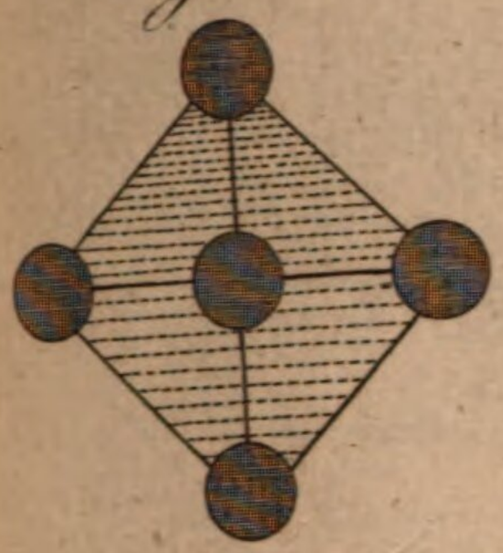
Fig. 42.

Fig. 43.



A. Bell Prin. Wal. Sculptor fecit.

Fig. 44.



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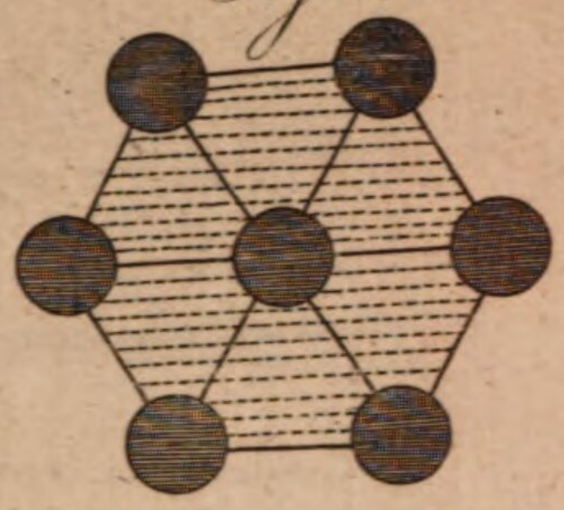
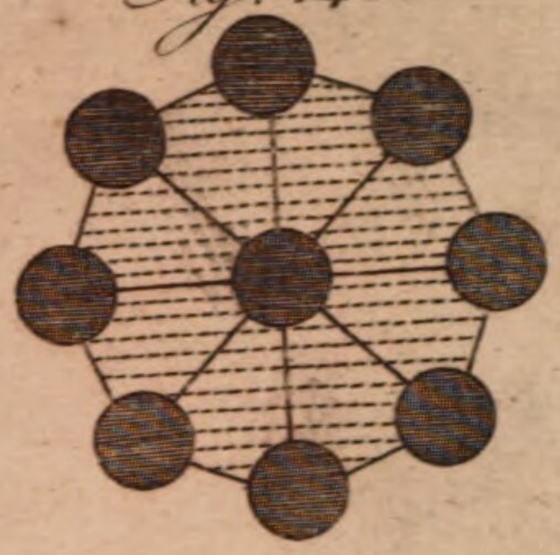


Fig. 46.



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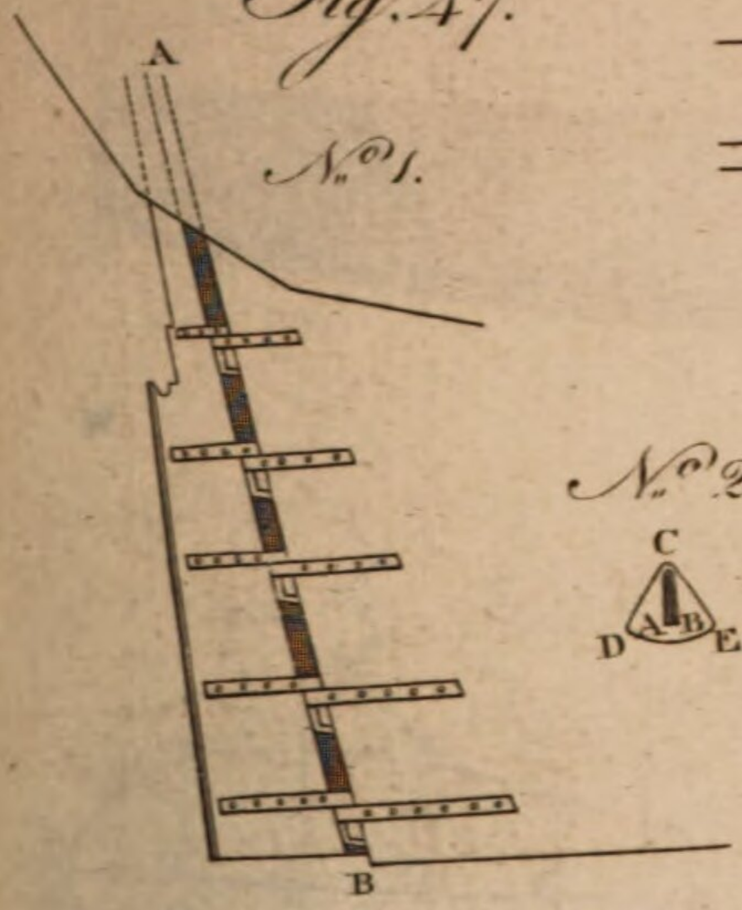

No. 1.

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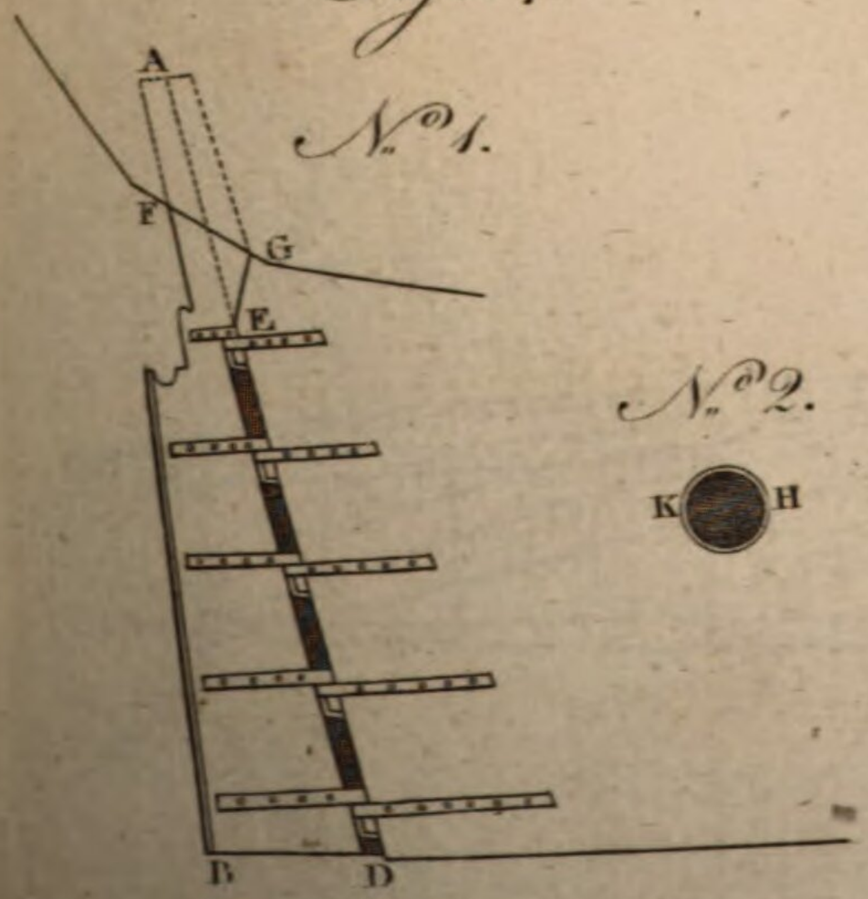
Fig. 48.



No. 1.

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Fig. 49.

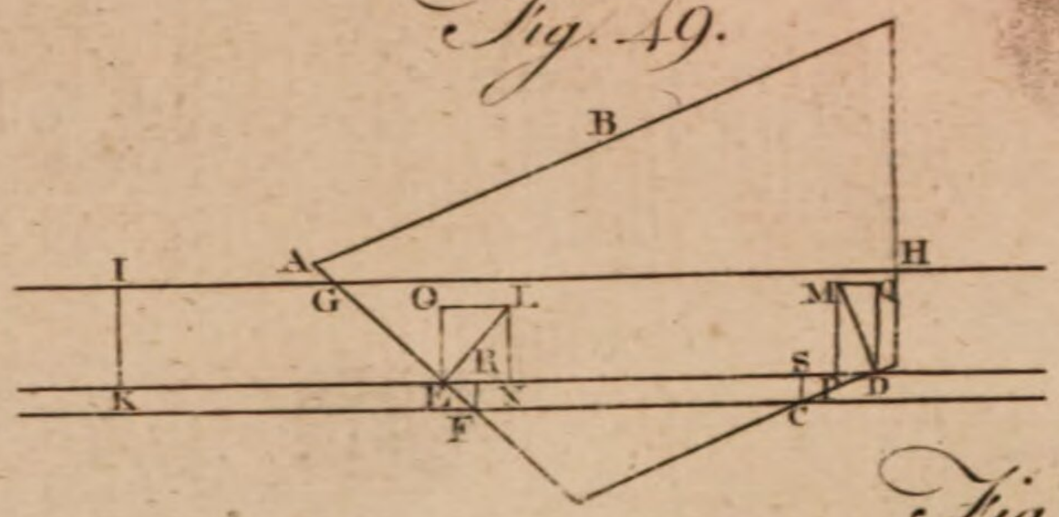
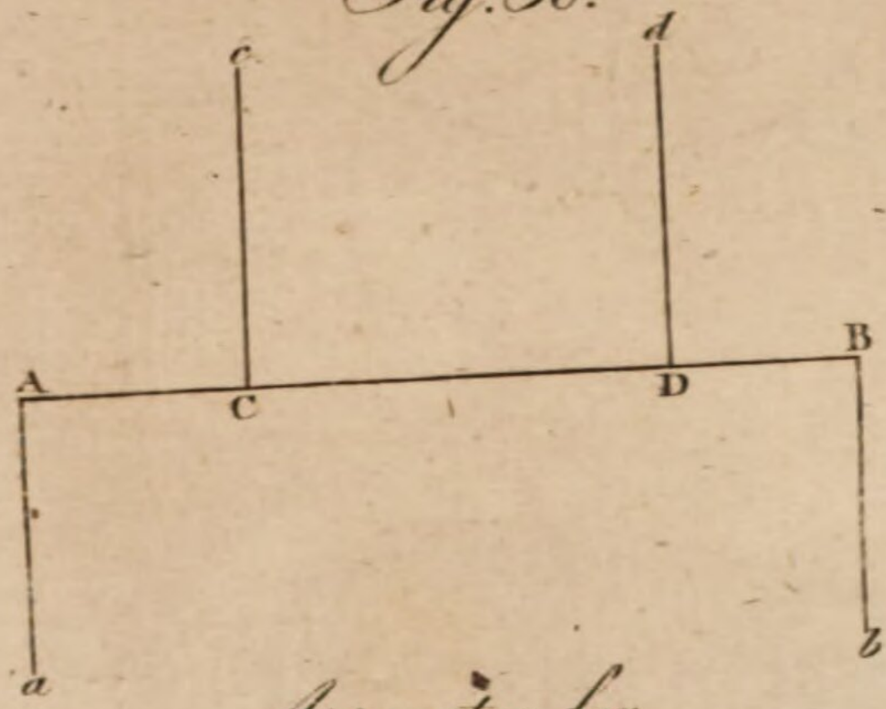


Fig. 50.



Apparatus for Seltzer water.

Fig. 2.

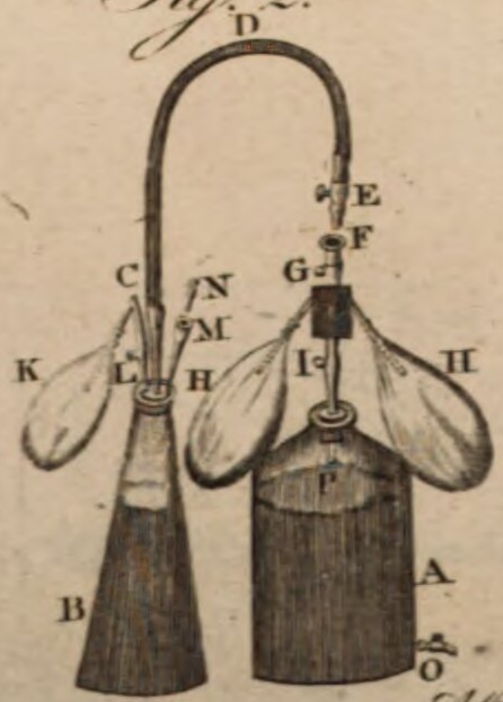


Fig. 1.

A Bell Prin. Wal. Sculptor fecit.

Fig. 51.

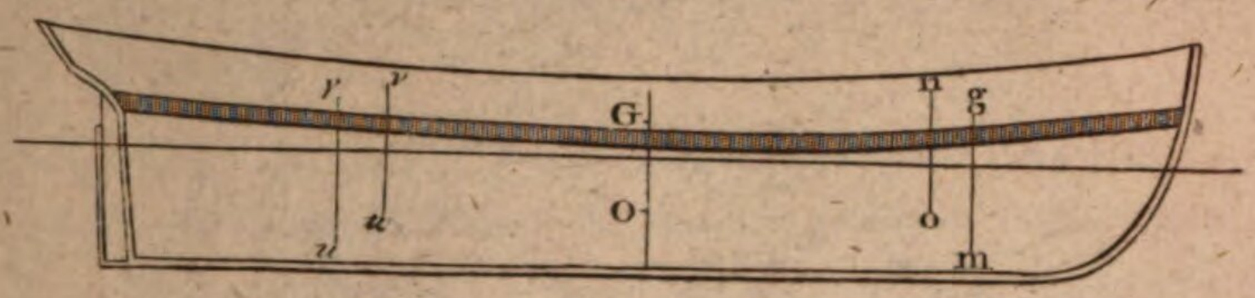


Fig. 52.

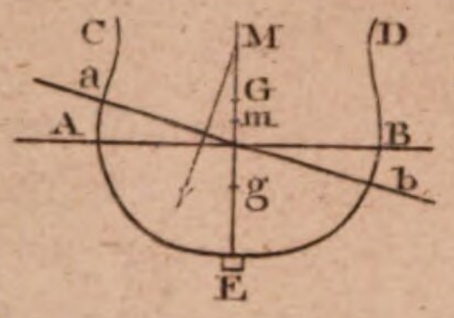


Fig. 53.

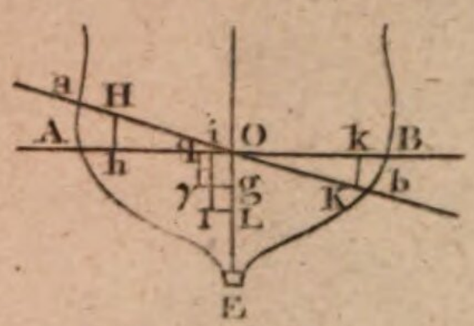


Fig. 54.

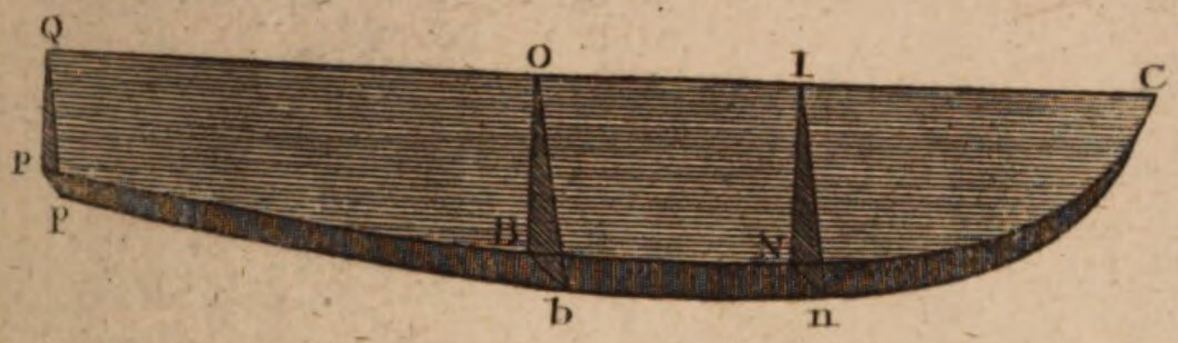


Fig. 55.

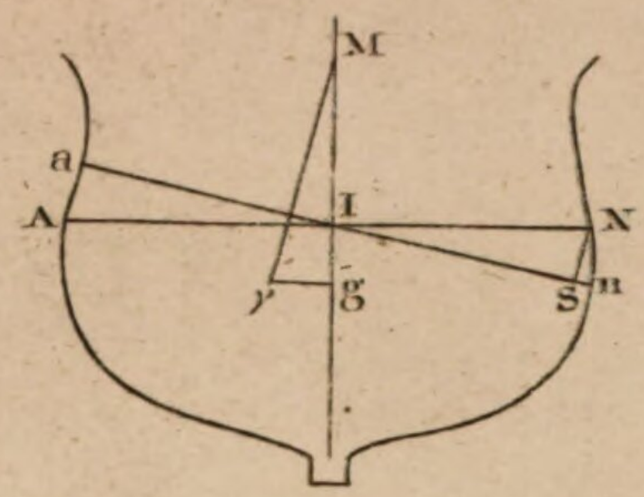


Fig. 56.

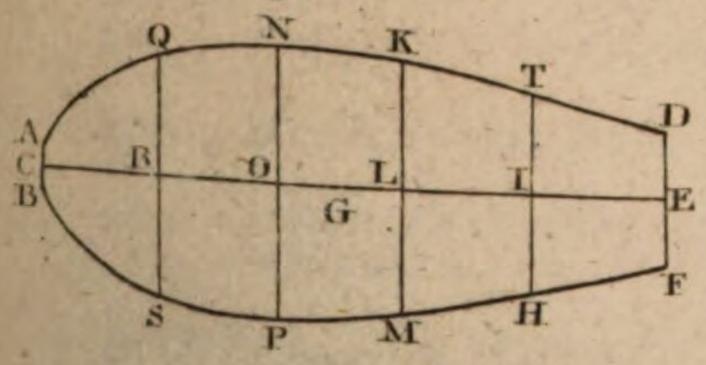


Fig. 57.

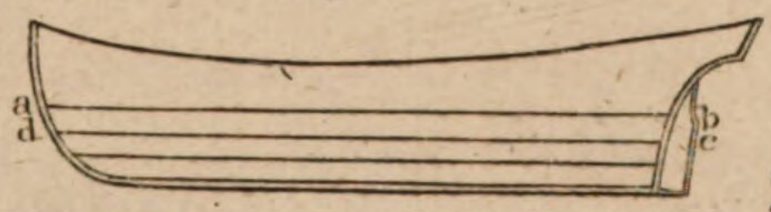


Fig. 58.

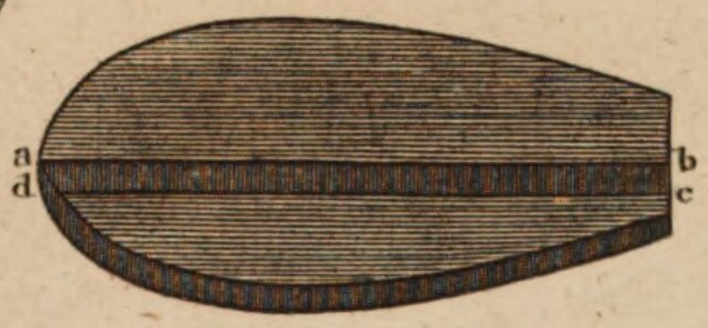


Fig. 59.

A. Bell Prin. Wal. Sculptor fecit.

Centre of Gravity.

The areas of theſe ſeveral planes, calculated by the common method, will be as follow:

5558.90	for that of the plane, and its momentum 5558.9×84 =	466947.6000
199.13	for that of double the trapezium ARg 8, and its momentum 199.13×9 =	1792.1700
214.59	for that of double the trapezium G$o\gamma\gamma$, and its momentum 214.59×159.22 =	34167.0236
0.77	for that of the ſection of the ſtern-poſt, and its momentum 0.77×0.29 =	0.2233
0.77	for that of the ſection of the ſtem, and its momentum 0.77×169.76 =	130.7152
5974.16	Sum - - - -	503037.7321

Now $\frac{503037.7321}{5974.16} = 84.2$, the diſtance of the centre of gravity of the whole ſection from the aft ſide of the ſtern-poſt.

II. *Determination of the Centre of Gravity of the ſecond Horizontal Section.*

To find the diſtance of the centre of gravity of double the plane 8fnG from its firſt ordinate 8f.

Ordinates.			Double Ord.			1. Factors.	1. Products.			2. Fact.	2. Products.		
Feet.	In.	Pts.	Feet.	In.	Pts.		Feet.	In.	Pts.		Feet.	In.	Pts.
11	2	3	22	4	6	$0\frac{1}{6}$	3	8	9	$0\frac{1}{2}$	11	2	3
15	3	0	30	6	0	1	30	6	0	1	30	6	0
17	5	0	34	10	0	2	69	8	0	1	34	10	0
18	10	3	37	8	6	3	113	1	6	1	37	8	6
19	10	6	39	9	0	4	159	0	0	1	39	9	0
20	7	0	41	2	0	5	205	10	0	1	41	2	0
21	0	3	42	0	6	6	252	3	0	1	42	0	6
21	2	0	42	4	0	7	296	4	0	1	42	4	0
21	0	6	42	1	0	8	336	8	0	1	42	1	0
20	10	9	41	9	6	9	376	1	6	1	41	9	6
20	6	6	41	1	0	10	410	10	0	1	41	1	0
19	10	0	39	8	0	11	436	4	0	1	39	8	0
18	6	0	37	0	0	12	444	0	0	1	37	0	0
15	9	6	31	7	0	13	410	7	0	1	31	7	0
11	2	9	22	5	6	$((3\times15)-4)\times\frac{1}{6}$	153	5	6	$0\frac{1}{2}$	11	2	9
273	2	3	546	4	6		3698	5	3		523	11	6

Hence the diſtance of the centre of gravity of double the plane 8fnG from its firſt ordinate 8n is

$\frac{3698\ 5\ 3}{523\ 11\ 6} \times 10.0.4 = \frac{3698.43}{523.95} \times 10.03$ = - - - - 70.79

Diſtance of this ordinate from the aft ſide of the ſtern-poſt - - - 13.5

Diſtance of the centre of gravity of the above plane from the aft ſide of poſt - - 84.29

Diſtance of the centre of gravity of double the trapezium ARf8 from its ordinate AR - 8.38
Diſtance of this ordinate from aft ſide of ſtern-poſt - - - 0.57

Diſtance of the centre of gravity of the trapezium from the aft ſide of the poſt - - 8.95

Diſtance of the centre of gravity of the trapezium before the ordinate Gn from that ordinate 5.74
Diſtance of that ordinate from the aft ſide of the poſt - - - 153.78

Diſtance of the centre of gravity of the trapezium from the aft ſide of the poſt - - 159.52

Diſtance of the centre of gravity of the ſection of the ſtern-poſt from the aft ſide of the poſt - 0.29
Diſtance of the centre of gravity of the ſection of the ſtem from the aft ſide of the poſt - 169.76

The areas of theſe ſeveral plans being calculated, will be as follow:

5255.22	for that of the plan 8fnG, and its momentum 5255.22×84.29 = -	442962.4938
153.11	for that of double the trapezium ARf8, and its momentum 153.11×8.95 =	1370.3345
182.40	the area of the trapezium before, and its momentum 182.40×159.52 = -	29096.4480
0.77	the area of the ſection of the ſternpoſt, and its momentum 0.77×0.29 = -	0.2233
0.77	the area of the ſection of the ſtem, and its momentum 0.77×169.76 = -	130.7152
5592.27	Sum - - - - -	473560.2148

Centre of Gravity. Now $\frac{473560.2148}{5952.27} = 84.68$, the distance of the centre of gravity of the whole section from the aftside of the stern-post. Centre of Gravity.

III. *Determination of the Centre of Gravity of the third Horizontal Section.*

Distance of the centre of gravity of double the plan 8 *e m* G from its first ordinate 8 *e*.

Ordinates. Feet.	In.	Pts.	Double Ord. Feet.	In.	Pts.	1. Factors.	1. Products. Feet.	In.	Pts.	2. Fact.	2. Products. Feet	In.	Pts.
6	7	6	13	3	0	$0\frac{1}{6}$	2	2	6	$0\frac{1}{2}$	6	7	6
11	7	6	23	3	0	1	23	3	0	1	23	3	0
15	1	0	30	2	0	2	60	4	0	1	30	2	0
17	1	3	34	2	6	3	102	7	6	1	34	2	6
18	3	0	36	6	0	4	146	0	0	1	36	6	0
19	3	0	38	6	0	5	192	6	0	1	38	6	0
19	9	0	39	6	0	6	237	0	0	1	39	6	0
20	0	0	40	0	0	7	280	0	0	1	40	0	0
20	0	0	40	0	0	8	320	0	0	1	40	0	0
19	8	3	39	4	6	9	354	4	6	1	39	4	6
19	1	3	38	2	6	10	382	1	0	1	38	2	6
18	1	0	36	2	0	11	397	10	0	1	36	2	0
16	3	9	32	7	6	12	391	6	0	1	32	7	6
13	2	3	26	4	6	13	342	10	6	1	26	4	6
8	4	6	16	9	0	$\left((3\times15)-4\right)\times\frac{1}{6}=$	114	5	6	$0\frac{1}{2}$	8	4	6
242	5	3	484	10	6		3347	0	6		469	10	6

Hence the distance of the centre of gravity of double the plane 8 *e m* G from its first ordinate 8 *e* is

$= \frac{3347\ 0\ 6}{469\ 10\ 6} \times 10\ 0\ 4 = \frac{3347.04}{469.87} \times 10.03 =$ - - 71.44

Distance of this ordinate from the aft side of the post - - -	13.5
Hence the distance of the centre of gravity of this plan from the aft side of the post is -	84.94
Distance of the centre of gravity of double the trapezium AR *e* 8, from its ordinate AR -	8.03
Distance of this ordinate from the aft side of the post - - -	0.58
Distance of the centre of gravity of this trapezium from the aft side of the post -	8.61
Distance of the centre of gravity of the foremost trapezium from its ordinate G *m* -	5.19
Distance of this ordinate from the aft side of the post - - -	153.78
Distance of the centre of gravity of this trapezium from the aft side of the post -	158.97
Distance of the centre of gravity of the section of the post from the aft side of the post -	0.29
Distance of the centre of gravity of the section of the stem from the aft side of the post -	169.76

The areas of these several planes will be found to be as follow:

4712.7961	for that of double the plan 8 *e m* G, and its momentum 4712.7961 × 84.94 =	400304.9007
93.84	the area of double the trapezium AR 3 *e* 88, and its momentum 93.84 × 8.61 =	807.9624
131.1	for the area of foremost trapezium, and its momentum 131.1 × 158.97 = -	20840.967
0.77	the area of the section of the post, and its momentum 0.77 × 0. 29 = -	0.2233
0.77	the area of the section of the stem, and its momentum 0.77 × 169.76 = -	130.7152
4939.2761	Sum - - - -	422084.7706

Now $\frac{422084.7706}{4939.2761} = 85.45$, the distance of the centre of gravity of the whole section from the aft side of the post.

IV. *De-*

IV. *Determination of the Centre of Gravity of the Fourth Horizontal Section.*

Diſtance of the centre of gravity of double the plan 8 *d l* G from its firſt ordinate 8 *d*.

Ordinates. Feet.	In.	Pts.	Double Ord. Feet.	In.	Pts.	1. Factors.	1. Products. Feet.	In.	Pts.	2. Fact.	2. Products. Feet.	In.	Pts.
3	3	6	6	7	0	$0\frac{1}{6}$	1	1	2	$0\frac{1}{2}$	3	3	6
7	9	0	15	6	0	1	15	6	0	1	15	6	0
11	11	0	23	10	0	2	47	8	0	1	23	10	0
14	8	9	29	5	6	3	88	4	6	1	29	5	6
16	3	0	32	6	0	4	130	0	0	1	32	6	0
17	4	9	34	9	6	5	173	11	5	1	34	9	6
18	1	9	36	3	6	6	217	9	0	1	36	3	6
18	5	0	36	10	0	7	257	10	0	1	36	10	0
18	3	0	36	6	0	8	292	0	0	1	36	6	0
17	10	9	35	9	6	9	322	1	6	1	35	9	6
17	2	6	34	5	0	10	340	10	0	1	34	5	0
15	10	3	31	8	6	11	348	9	6	1	31	8	6
13	6	0	27	0	0	12	324	0	0	1	27	0	0
9	7	6	19	3	0	13	250	3	0	1	19	3	0
5	4	9	10	9	6	$\left((3\times15)-4\right)\times\frac{1}{8}$	73	8	11	$0\frac{1}{2}$	5	4	9
205	7	6	411	3	0		2883	11	0		402	6	9

Hence the diſtance of the centre of gravity of double the plane 8 *d l* G from its firſt ordinate 8 *d*, is

$= \frac{2883\ 11\ 0}{402\ 6\ 9} \times 10\ 0\ 4 = \frac{2883.916}{402.56} \times 10.03 =$ - - 71.85

Diſtance of this ordinate from the aft ſide of the poſt - - - 13.5

Diſtance of the centre of gravity of the plan from the aft ſide of the poſt - - 85.35

Diſtance of the centre of gravity of double the trapezium AR *d* 8 from its ordinate AR - 7.89
Diſtance of this ordinate from the aft ſide of the poſt - - - 0.58

Diſtance of the centre of gravity of the trapezium from the aft ſide of the poſt - 8.47

Diſtance of the centre of gravity of the foremoſt trapezium from its ordinate G *l* - 4.83
Diſtance of this ordinate from aft ſide of the poſt - - - 153.78

Diſtance of the centre of gravity of the trapezium from the aft ſide of the poſt - 158.61

Diſtance of the centre of gravity of the ſection of the poſt from its aft ſide - 0.29
Diſtance of the centre of gravity of the ſection of the ſtem from the aft ſide of the poſt - 169.76

The areas of theſe ſeveral plans being calculated, will be as follow:

4037.6768	for that of double the plan 8 *d l* G, and its momentum 4037.6768 × 85.35 =	344615.7149
51.12	the area of double the trapezium AR *d* 8, and its momentum 51.12 × 8.47 =	432.9864
79.16	the area of the foremoſt trapezium, and its momentum 79.16 × 158.61 =	12555.5676
0.77	the area of the ſection of the poſt, and its momentum 0.77 × 0.29 =	0.2233
0.77	the area of the ſection of the ſtem, and its momentum 0.77 × 169.76 =	130.7152
4169.4968	Sum - - -	357735.2074

Then $\frac{357735.2074}{4169.4968} = 85.80$, the diſtance of the fourth horizontal ſection from the aft ſide of the ſtern-poſt.

V. *Determination of the Centre of Gravity of the fifth Horizontal Section.*

Diſtance of the centre of gravity of double the plan 8 *c k* G from its firſt ordinate 8 *c*.

Ordinates. Feet.	In.	L.	Double Ord. Feet	In.	L.	1. Factors.	1. Products. Feet.	In.	L.	2. Fact.	2. Products. Feet.	In.	L.
1	9	0	3	6	0	$0\frac{1}{6}$	0	7	0	$0\frac{1}{2}$	1	9	0
4	6	0	9	0	0	1	9	0	0	1	9	0	0
Over 6	3	0	12	6	0		9	7	0		10	9	0

Centre of Gravity.	Ordinates. Feet.	In.	L.	Double Ord. Feet.	In.	L.	1. Factors.	1. Products. Feet.	In.	L.	2. Fact.	2. Products. Feet.	In.	L.	Centre of Gravity.
Brought over	6	3	0	12	6	0		9	7	0		10	9	0	
	8	3	0	16	6	0	2	33	0	0	1	16	6	0	
	11	8	3	23	4	6	3	70	1	6	1	23	4	6	
	13	10	3	27	8	6	4	110	10	0	1	27	8	6	
	15	3	0	30	6	0	5	152	6	0	1	30	6	0	
	16	0	3	32	0	6	6	192	3	0	1	32	0	6	
	16	5	0	32	10	0	7	229	10	0	1	32	10	0	
	16	3	0	32	6	0	8	260	0	0	1	32	6	0	
	15	9	0	31	6	0	9	283	6	0	1	31	6	0	
	14	10	0	29	8	0	10	296	8	0	1	29	8	0	
	12	10	3	25	8	6	11	282	9	6	1	25	8	6	
	9	8	9	19	5	6	12	233	6	0	1	19	5	6	
	6	1	6	12	3	0	13	159	3	0	1	12	3	0	
	3	3	0	6	6	0	$((3\times15)-4)\times\frac{1}{6}$	44	5	0	$0\frac{1}{2}$	3	3	0	
	166	6	3	333	0	6		2358	3	0		328	0	6	

Hence the diſtance of the centre of gravity of double the plane 8 *c k* G from its firſt ordinate is $\frac{2358\ 3\ 0}{328\ 0\ 6}$

$\times 10\ 0\ 4 = \frac{2358.25}{328.04} \times 10.03 =$	-	72.10
Diſtance of this ordinate from the aft ſide of the poſt	-	13.50
Diſtance of the centre of gravity of the plan from the aft ſide of the poſt	-	85.60
Diſtance of the centre of gravity of double the trapezium AR *c* 8 from its ordinate AR	-	7.42
Diſtance of this ordinate from the aft ſide of poſt	-	0.58
Diſtance of centre of gravity of trapezium from aft ſide of the poſt	-	8.00
Diſtance of the centre of gravity of the foremoſt trapezium from its ordinate G *k*	-	4.22
Diſtance of this ordinate from the aft ſide of poſt	-	153.78
Diſtance of the centre of gravity of the foremoſt trapezium from the aft ſide of the poſt		158.00
Diſtance of the centre of gravity of the ſection of the poſt from the aft ſide of poſt	-	0.29
Diſtance of the centre of gravity of the ſection of the ſtem from the aft ſide of poſt	-	169.76

The areas of theſe ſeveral planes being calculated, will be as follow.

3290.2412	for the area of double the plan 8 *c k* G, and its momentum 3290.2412 × 85.6 =	281644.6467
31.21	the area of double the trapezium AR *c* 8, and its momentum 31.21 × 8 = -	249.68
42.43	the area of the foremoſt trapezium, and its momentum 42.43 × 158 = -	6703.94
0.77	the area of the ſection of the poſt, and its momentum 0.77 × 0.29 = -	0.2233
0.77	the area of the ſection of the ſtem, and its momentum 0.77 × 169.76 = -	130.7152
3365.4212	Sum - - - -	288729.2052

Now $\frac{288729.2052}{3365.4212} = 85.79$, the diſtance of the centre of gravity of the whole ſection from the aft ſide of the ſtern.

VI. *Determination of the Centre of Gravity of the ſixth Horizontal Section.*

Diſtance of the centre of gravity of double the plan 8 *b i* G from its firſt ordinate 8 *b*.

Ordinates. Feet.	In.	L.	Double Ord. Feet.	In.	L.	1. Factors.	1. Products. Feet.	In.	L.	2. Fact.	2. Products. Feet.	In.	L.
1	0	0	2	0	0	$0\frac{1}{6}$	0	4	0	$0\frac{1}{2}$	1	0	0
2	5	0	4	10	0	1	4	10	0	1	4	10	0
4	5	0	8	10	0	2	17	8	0	1	8	10	0
7	3	6	14	7	0	3	43	9	0	1	14	7	0
10	1	9	20	3	6	4	81	2	0	1	20	3	6
12	1	3	24	2	6	5	121	0	6	1	24	2	6
Over 37	4	6	74	9	0		268	9	6		73	9	0

Centre of Gravity.		Feet.	In.	L.	Feet.	In.	L.		Feet.	In.	L.		Feet.	In.	L.	Centre of Gravity.
	Broughtover	37	4	6	74	9	0		268	9	6		73	9	0	
		13	3	0	26	6	0	6	159	0	0	1	26	6	0	
		13	9	9	27	7	6	7	193	4	6	1	27	7	6	
		13	7	0	27	2	0	8	217	4	0	1	27	2	0	
		12	8	0	25	4	0	9	228	0	0	1	25	4	0	
		10	6	6	21	1	0	10	210	10	0	1	21	1	0	
		7	1	0	14	2	0	11	155	10	0	1	14	2	0	
		4	7	3	9	2	6	12	110	6	0	1	9	2	6	
		2	10	6	5	9	0	13	74	9	0	1	5	9	0	
		1	6	9	3	1	6	$\times((3\times15)-4)\times\frac{1}{6}$	21	4	3	$0\frac{1}{2}$	1	6	9	
		117	4	3	234	8	6		1639	9	3		232	1	9	

Hence the diſtance of the centre of gravity of double the plane 8 *b v* G from its firſt ordinate 8 *b* is

$\frac{1639\ 9\ 3}{232\ 1\ 9} \times 10\ 0\ 4 = \frac{1639.77}{232.14} \times 10.03 =$ - - - 70.84

Diſtance of this ordinate from aft ſide of poſt - - - 13.50

Hence the diſtance of the centre of gravity of the plan from the aft ſide of the poſt is - 84.34

Diſtance of the centre of gravity of the trapezium AR *b* 8 from its ordinate AR - 6.88
Diſtance of this ordinate from the aft ſide of the poſt - - 0.58

Diſtance of the centre of gravity of the trapezium from the aft ſide of the poſt - 7.46

Diſtance of the centre of gravity of the foremoſt trapezium from the ordinate G *i* - 2.92
Diſtance of this ordinate from the aft ſide of poſt - - - 153.78

Diſtance of the centre of gravity of this trapezium from the aft ſide of the poſt - 156.70

Diſtance of the centre of gravity of the ſection of the poſt from its aft ſide - - 0.29
Diſtance of the centre of gravity of the ſection of the ſtem from the aft ſide of the poſt - 169.76

The areas of theſe plans will be found to be as follow:

2328.3642	for that of double the plan 8 *b i* G, and its momentum 2328.3642 × 84.34 =	196374.2366
21.52	for the area of double the trapezium AR *b* 8, and its momentum 21.52 × 7.46 =	160.5392
15.04	the area of the foremoſt trapezium, and its momentum 15.04 × 156.7 = -	2356.7680
0.77	the area of the ſection of the poſt, and its momentum 0.77 × 0.29 = -	0.2233
0.77	the area of the ſection of the ſtem, and its momentum 0.77 × 169.76 = -	130.7152
2366.4642	Sum - - -	199022.4823

Now $\frac{199022.4823}{2366.4642} = 84.1$, the diſtance of the centre of gravity of the whole from the aft ſide of the poſt.

VII. *Determination of the Centre of Gravity of the ſeventh Horizontal Section.*

Diſtance of the centre of gravity of double the plan 8 *a b* G from its firſt ordinate 8 *a*.

Ordinates.			Double Ord.			1. Factors.	1. Products.			2. Fact.	2. Products.		
Feet.	In.	L.	Feet	In.	L.		Feet.	In.	L.		Feet.	In.	L.
0	8	0	1	4	0	$0\frac{1}{6}$	0	2	8	$0\frac{1}{2}$	0	8	0
1	1	6	2	3	0	1	2	3	0	1	2	3	0
1	7	6	3	3	0	2	6	6	0	1	3	3	0
1	10	9	3	9	6	3	11	4	6	1	3	9	6
2	1	3	4	2	6	4	16	10	0	1	4	2	6
2	1	0	4	2	0	5	20	10	0	1	4	2	0
1	10	9	2	9	6	6	22	9	0	1	3	9	6
1	8	0	3	4	0	7	23	4	0	1	3	4	0
1	1	0	2	2	0	8	17	4	0	1	2	2	0
0	9	0	1	6	0	9	13	6	0	1	1	6	0
0	8	0	1	4	0	10	13	4	0	1	1	4	0
Over 6 15	6	9	30	1	6		148	3	2		30	5	6

Centre of Gravity.		Feet.	In.	L.	Feet.	In.	L.		Feet.	In.	L.		Feet.	In.	L.	Centre of Gravity.
	Brought over	15	6	9	30	1	6		148	3	2		30	5	6	
		0	8	0	1	4	0	11	14	8	0	1	1	4	0	
		0	8	0	1	4	0	12	16	0	0	1	1	4	0	
		0	8	0	1	4	0	13	17	4	0	1	1	4	0	
		0	8	0	1	4	0	$((3\times15)-4)\times\frac{1}{3}$	9	1	4	$0\frac{1}{2}$	0	8	0	
		18	2	9	36	5	6		205	4	6		35	1	6	

Hence the diſtance of the centre of gravity of double this plane from its firſt ordinate is $\frac{205\ 4\ 6}{35\ 1\ 6}\times 10\ 0\ 4$

$= \frac{205.37}{35.12}\times 10.83 =$ - - 58.65

The diſtance of this ordinate from aft ſide of poſt = - - 13.50

Hence the diſtance of the centre of gravity of this plane from the aft-ſide of the poſt is 72.15

Diſtance of the centre of gravity of double the rectangle AR *a* 8 from its ordinate AR 6.45

Diſtance of this ordinate from the aft ſide of the poſt - - 0.58

Diſtance of the centre of gravity of this rectangle from the aft ſide of the poſt 7.03

Diſtance of the centre of gravity of the foremoſt rectangle from its ordinate 7′ 7 *e* 7′ 1.25

Diſtance of this ordinate from the aft ſide of the poſt - - 153.78

Diſtance of the centre of gravity of this rectangle from the aft ſide of the poſt 155.03

Diſtance of the centre of gravity of the ſection of the poſt from its aft ſide 0.29

Diſtance of the centre of gravity of the ſection of the ſtem from the aft ſide of the poſt - - 169.76

Now the areas of theſe ſeveral plans being calculated will be as follows.

352.2536,	the area of double the plan 8 *a b* G, and its momentum 352.2536×72.15 =	25415.0972
17.1570,	the area of double the rectangle AR *a* 8, and its momentum 17.1570×7.03 =	120.6137
3.3250,	the area of the foremoſt rectangle, and its momentum 3.3250×155.03 =	515.4747
0.77,	the area of the ſection of the port, and its momentum 0.77×0.29 =	0.2233
0.77,	the area of the ſection of the ſtem and its momentum 0.77×169.76 =	130.7152
374.2756	Sum	26182.1242

Then $\frac{26182.1242}{374.2756} = 69.95$, the diſtance of the centre of gravity of the whole ſection from the aft ſide of the poſt.

VIII. *Determination of the Centre of Gravity of the eighth Plane.*

This plane is equal in length to the ſeventh horizontal plane, and its breadth is equal to that of the keel. The diſtance between the ſeventh and eighth planes is three feet, but which is here taken equal to 2 feet $11\frac{1}{2}$ inches.

Diſtance between the aft ſide of the poſt and the firſt ordinate -	13.5
Fourteen intervals between the fifteen ordinates, each interval being 10.03 feet	140.42
Diſtance of the laſt ordinate from the fore foot	2.2
Hence the length of the eighth plane is	156.12
Which multiplied by the breadth -	1.33
The product is the area of this plane	208.
The diſtance of its centre of gravity from the aft ſide of the poſt, being equal to half its length, is - -	78.06

The centres of gravity of theſe eight planes being found, the diſtance of the centre of gravity of the bottom of the ſhip from the aft ſide of the poſt, and alſo its altitude, may from thence be eaſily determined.

From the principles already explained, the diſtance of the centre of gravity of the bottom from the aft ſide of the poſt, is equal to the ſum of the momentums of an infinite number of horizontal planes, divided by the ſum of theſe planes, or, which is the ſame, by the ſolidity of the bottom. As, however, we have no more than eight planes, we muſt therefore conceive their momentums as the ordinates of a curve, whoſe diſtances may be the ſame as that of the horizontal planes. Now the ſum of theſe ordinates minus half the ſum of the extreme ordinates being multiplied by their diſtance, gives the ſurface of the curve; of which any ordinate whatever repreſents the momentum of the horizontal plane at the ſame altitude as theſe ordinates; and the whole ſurface will repreſent the ſum of the momentums of all the horizontal planes.

Hor. Planes.	Fact.	Products.	Momentums.	Fact.	Products.
5974.16	$0\frac{1}{2}$	2987.08	503037.73	$0\frac{1}{2}$	251518.86
5592.27	1	5592.27	473560.21	1	473560.21
4939.27	1	4939.27	422084.77	1	422084.77
4169.50	1	4169.50	357735.21	1	357735.21
3365.42	1	3365.42	288729.20	1	288729.20
2366.46	1	2366.46	199022.48	1	199022.48
374.27	1	374.27	21682.12	1	21682.12
208.00	$0\frac{1}{2}$	104.00	16236.48	$0\frac{1}{2}$	8118.24
		23898.27			2022451.09

Now $\frac{2022451.09}{23898.27} = 84.63$, the diſtance of the centre

Centre of Gravity

centre of gravity of the bottom of the ſhip from the aft ſide of the poſt.

The height of the centre of gravity of the bottom above the lower edge of the keel may be determined by the ſame principles. Thus,

To one ſixth of the lowermoſt horizontal ſection add the product of one ſixth of the uppermoſt ſection by three times the number of ſections minus four the ſecond ſection in aſcending, twice the third, three times the fourth, &c.; and to half the ſum of the extreme planes add all the intermediate ones. Now the firſt of theſe ſums, multiplied by the diſtance between the planes or ſections, and divided by the ſecond ſum, gives the altitude of the centre of gravity of the bottom of the ſhip above the lower edge of the keel as required.

Hor. Planes.	1ſt Fact.	1ſt Products.	2d Fact.	2d Products.
208.00	$0\frac{1}{6}$	34.67	$0\frac{1}{2}$	104.00
374.27	1	374.27	1	374.27
2366.46	2	4732.92	1	2366.46
3365.42	3	10096.26	1	3365.42
4169.50	4	16678.00	1	4169.50
4939.27	5	24696.35	1	4939.27
5592.27	6	33553.62	1	5592.27
5974.16	$((3\times 8)-4)\times\frac{1}{6}$	19913.87	$0\frac{1}{2}$	2987.08
		110079.96		23898.27

Now $\frac{110079.96}{23898.27} \times 2.95 = 13.588$, the height of the centre of gravity of the bottom of the ſhip above the lower edge of the keel.

We have now found the diſtance of the centre of gravity of the bottom of the ſhip from the aft ſide of the poſt, and its altitude above the lower edge of the keel. Hence the ſhip being ſuppoſed in an upright poſition, this centre of gravity will neceſſarily be in the vertical longitudinal ſection which divides the ſhip into two equal and ſimilar parts; the poſition of this centre is therefore determined.

70 Determination of the height of the metacenter above the centre of gravity.

It now remains to find the height of the metacenter above the centre of gravity; the expreſſion for this altitude, as found in Chap. III. is $\frac{\frac{2}{3}\int y^3 x}{V}$; which we ſhall now apply to determine the metacenter of the ſhip of of 74 guns, whoſe centre of gravity we have already found.

Ord. of the Plane of Floatation.			Ft. & dec. of Foot.	Cub. of Ordinates.
Ft.	Inch.			
14	9	0	14.7	3209.046
17	1	6	17.1	5000.211
18	9	0	18.7	6591.797
19	10	0	19.8	7762.392
20	7	6	20.6	8741.816
21	1	9	21.2	9595.703
21	6	3	21.5	9938.375
21	7	9	21.7	10289.109
21	7	9	21.7	10289.109
21	7	6	21.7	10289.109
21	4	0	21.3	9663.597
20	10	6	20.9	9129.329
19	9	0	19.7	7703.734
17	4	6	17.4	5268.024
13	1	3	13.1	2248.091
291	1	3	291.1	115719.442

Centre of Gravity.

Ordinate at 10.03 feet abaft the ordinate $8g = 4$, of which the cube is 64, and $64 \times \frac{1}{2}$		32.
Ordinate at 10.03 feet afore the ordinate $Go = 6$, cube of which is 216, and $216 \times \frac{1}{2}$		108.
Sum		115859.442
Diſtance between the ordinates		10.03
Product		1162070.20326
Half the cube of the aftermoſt ordinate	32.	
Half the cube of the thickneſs of the ſtem	0.14	
Sum	32.14	
Diſtance between the ordinates	3.0	
Product		96.42
Half the cube of the foremoſt ordinate	108.	
Half the cube of the thickneſs of the ſtem	.14	
Sum	108.14	
Diſtance between the ordinates	5.5	
Product		594.77
$\int y^3 x$		1162761.39326
$2\int y^3 x$		2325522.78652
$\frac{2}{3}\int y^3 x$		775174.26217

The ſolidity of the bottom is $2527\frac{3}{4}$ tons $= 70018.67$ cubic feet: hence $\frac{\frac{2}{3}\int y^3 x}{V} = \frac{77517.26}{70018.67} = 11.07$ feet, the altitude of the metacenter above the centre of gravity of the bottom of the ſhip.

APPENDIX.

When a ſhip is built, ſhe muſt be fitted with maſts, yards, ſails, ropes, and blocks, or, in other words, ſhe muſt be *rigged* before ſhe can go to ſea. To complete this article, it may therefore be thought neceſſary to treat of the art of rigging veſſels; but we have elſewhere (ſee *Maſt-Rigging*, Rope-Making, and Sail) ſhown how the ſeveral parts of a ſhip's rigging are made; and the art of putting them properly together, ſo as to make the ſhip beſt anſwer the purpoſe for which ſhe is intended, depends upon a juſt knowledge of the impulſe and reſiſtance of fluids, and of the theory and practice of ſeamanſhip. (See *Resistance of Fluids* and Seamanship). Nothing, therefore, of the ſubject is left to us here, except we were to ſtate in few words the progreſſive method of rigging ſhips; but there is no one undeviating mode which is purſued, as the nature of the operation is ſuch that all the parts of it may be advancing at the ſame time. We ſhall therefore take our leave of *ſhips* and *ſhip-building* with a few general obſervations on *ſail-making*, which were omitted under the article Sail, referring our readers for farther information to the very elegant work lately publiſhed, in

Appendix. two volumes 4to, on *the Elements and Practice of Rigging and Seamanship.*

Sails are made of canvas, of different textures, and are extended on or between the masts, to receive the wind that forces the vessel through the water. They are quadrilateral or triangular, as has been elsewhere described, and are cut out of the canvas cloth by cloth. The width is governed by the length of the yard, gaff, boom, or stay; the depth by the height of the mast. In the valuable work to which we have just referred, the following directions are given for cutting sails. "The width and depth being given, find the number of cloths the width requires, allowing for seams, tabling on the leeches, and slack cloth; and, in the depth, allow for tabling on the head and foot. For sails cut square on the head and foot, with gores only on the leeches, as some topsails, &c. the cloths on the head, between the leeches, are cut square to the depth; and the gores on the leeches are found by dividing the depth of the sail by the number of cloths gored, which gives the length of each gore. The gore is set down from a square with the opposite selvage; and the canvas being cut diagonally, the longest gored side of one cloth makes the shortest side of the next; consequently, the first gore being known, the rest are cut by it. In the leeches of topsails cut hollow, the upper gores are longer than the lower ones; and in sails cut with a roach leech, the lower gores are longer than the upper ones. This must be regulated by judgment, and care taken that the whole of the gores do not exceed the depth of the leech. Or, by drawing on paper the gored side of the sail, and delineating the breadth of every cloth by a convenient scale of equal parts of an inch to a foot, the length of every gore may be found with precision. Sails, gored with a sweep on the head or the foot, or on both, have the depth of their gores marked on the selvage, from the square of the given depth on each cloth, and are cut as above; the longest selvage of one serving to measure the shortest selvage of the next, beginning with the first gored cloth next the middle in some sails, and the first cloth next the mast leech in others. For those gores that are irregular no strict rule can be given; they can only be determined by the judgement of the sail-maker, or by a drawing.

"In the royal navy, mizen topsails are cut with three quarters of a yard hollow in the foot; but, in the merchant service, top and topgallant sails are cut with more or less hollow in the foot. Flying jibs are cut with a roach-curve on the stay, and a three-inch gore in each cloth, shortening from the tack to the clue. Lower studding-sails are cut with square leeches, and topmast and topgallant-mast studding sails with goring leeches.

Elements and Practice of Rigging and Seamanship, vol. i. p. 91.

"The length of reef and middle bands is governed by the width of the sail at their respective places; the leech-linings, buntline-cloths, top-linings, mast-cloths, and corner-pieces, are cut agreeably to the depth of the sail; each cloth and every article should be properly marked with charcoal, to prevent confusion or mistake. Sails that have bonnets are cut out the whole depth of the sail and bonnet included, allowing enough for the tablings on the foot of the sail and head and foot of the bonnet. The bonnet is cut off after the sail is sewed together. If a drabler is required, it is allowed for in the cutting out the same as the bonnet." Appendix.

When the cloth is thus properly cut, the different pieces are to be joined together in the form of a sail; and for doing this properly we have the following directions in the work already quoted. "Sails have a double flat seam, and should be sewed with the best English-made twine of three threads, spun 360 fathoms to the pound, and have from one hundred and eight to one hundred and sixteen stitches in every yard in length. The twine for large sails, in the royal navy, is waxed by hand, with genuine bees-wax, mixed with one-sixth part of clear turpentine; and, for small sails, in a mixture made with bees wax, 4 lb; hogs lard 5 lb; and clear turpentine 1 lb. In the merchant service, the twine is dipped in tar (L), softened with a proper proportion of oil.

"It is the erroneous practice of some sailmakers not to sew the seams any farther than where the edge is creased down for the tabling; but all sails should be sewed quite home to the end, and, when finished, should be well rubbed down with a rubber. In the merchant service seams are sometimes made broader at the foot than at the head, being stronger. Broad seams are not allowed to be made on courses, in the royal navy, but goring leeches are adopted in lieu of them. Boom-mainsails and the sails of sloops generally have the seams broader at the foot than at the head. The seams of courses and topsails are stuck or stitched up, in the middle of the seams, along the whole length, with double seaming-twine; and have from 68 to 72 stitches in a yard. In the merchant service it is common to stick the seams with two rows of stitches, when the sail is half worn, as they will then last till the sail is worn out.

"The breadth of the seams of courses, topsails, and other sails, in the royal navy, to be as follow, viz. courses and topsails, for 50 gun ships and upwards, one inch and a half, and, for 44 gun ships and under, one inch and a quarter, at head and foot; all other sails, one inch at head and foot.

"The tablings of all sails are to be of a proportionable breadth to the size of the sail, and sewed at the edge, with 68 to 72 stitches in a yard. Those for the heads of main and fore courses to be four to six inches wide; for sprit courses and mizens, drivers, and other boom sails, 3 to 4 inches wide; for topsails, 3 inches to 4 inches and a half; topgallant and sprit topsails, 3 inches; royal sails, 2 inches and a half; jib and other stay sails, 3 inches to 4 inches and a half, on the stay or hoist; and for studding sails, 3 inches to 4 inches on the head. Tablings on the foot and leeches of main and fore courses to be 3 inches to 5 inches broad; sprit course and topsails, 3 inches; topgallant and sprit topsails, 2 inches and a half; royals, 2 inches; fore leeches of mizen, driver, and other boomsails, 3 inches and a half to 4 inches; after leech, 3 inches; and on the foot 2 or 3 inches. Tablings on the after leech of jibs and other stay sails to be from 2 to 3 inches broad; and, on the foot, 2 to 2 inches and a half: on studding sail leeches one inch and a half to two inches and a half; and on the foot, from one to two inches.

"Main

(L) The dipping of the twine in tar, we are persuaded, is a very bad practice, for the reason assigned in ROPE-MAKING. See that article, n° 32.

Appendix.

"Main and fore courſes are lined on the leeches, from clue to earing, with one cloth ſeamed on and ſtuck or ſtitched in the middle, and have a middle band half way between the lower reef band and the foot, alſo four buntline cloths, at equal diſtances between the leeches, the upper end of which are carried under the middle band, that the lower ſide of the band may be tabled upon or ſewed over the end of the buntline pieces. They have likewiſe two reef bands; each in breadth one third of the breadth of the canvas; the upper one is one ſixth of the depth of the ſail from the head, and the lower band is at the ſame diſtance from the upper one; the ends go four inches under the leech linings, which are ſeamed over the reef bands. All linings are ſeamed on, and are ſtuck with 68 to 72 ſtitches in a yard.

"Main, fore, and mizen, topſails have leech linings, maſt and top linings, buntline cloths, middle bands and reef bands. The leech linings are made of one breadth of cloth, ſo cut and ſewed as to be half a cloth broad at the head, and a cloth and a half broad at the foot; the piece cut out being half the breadth of the cloth at one end, and tapering to a point at the other. The middle bands are put on half way between the lower reef and foot, the buntline cloths join the top-linings, and the buntline cloths and top-linings are carried up to the lower ſide of the middle band, which is tabled on them. The maſt lining is of two cloths, and extends from the foot of the ſail to the lower reef, to receive the beat or chafe of the maſt. The middle band is made of one breadth of canvas, of the ſame number as the top-lining. It is firſt folded and rubbed down, to make a creaſe at one third of the breadth; then tabled on the ſelvage, and ſtuck along the creaſe; then turned down, and tabled and ſtuck through both the double and ſingle parts, with 68 to 72 ſtitches in a yard. It is the opinion of many, that middle bands ſhould not be put on until the ſail is half worn.

"Main and fore topſails have three and ſometimes four reef bands from leech to leech, over the leech linings; the upper one is one eighth of the depth of the ſail from the head, and they are the ſame diſtance aſunder in the royal navy, but more in the merchant ſervice. The reef bands are each of half a breadth of canvas put on double; the firſt ſide is ſtuck twice, and the laſt turned over, ſo that the reef holes may be worked upon the double part of the band, which is alſo ſtuck with 68 to 72 ſtitches in a yard.

"The top-lining of topſails is of canvas n° 6 or 7. The other linings of this, and all the linings of other ſails, ſhould be of the ſame quality as the ſails to which they belong.

"Top-linings and maſt cloths are put on the aft ſide, and all other linings on the fore ſide, of ſails. Mizens are lined with one breadth of cloth from the clue five yards up the leech, and have a reef band ſewed on, in the ſame manner as on other ſails, at one fifth the depth of the ſail from the foot; they have alſo a nock-piece and a peek-piece, one cut out of the other, ſo that each contains one yard. Mizen topſails of 50 gun ſhips and upwards have three reefs, the upper one is one eighth of the depth of the ſail from the head, and the reefs are at the ſame diſtance aſunder. Mizen topſails of ſhips of 44 guns and under have two reefs one ſeventh part of the depth of the ſail aſunder, the upper one being at the ſame diſtance from the head. Main and main top ſtudding ſails have each one reef, at one eighth of the depth of the ſail from the head. Reef bands ſhould not be put on until the ſail is ſewed up, a contrary practice being very erroneous. Lower ſtayſails, fore top and main top ſtayſails, and flying jibs, have clue-pieces two yards long. Square tack ſtayſails have half a breadth of cloth at the fore part, with a clue-piece containing two yards, and a peek-piece, containing one yard.

Appendix

"Sails have two holes in each cloth, at the heads and reefs of courſes, topſails, and other ſquare ſails; one hole in every yard in the ſtay of flying jibs, and one in every three quarters of a yard in the ſtays of ſquare tack and other ſtayſails. Theſe are made by an inſtrument called a *pegging awl*, or a ſtabber, and are fenced round by ſtitching the edge to a ſmall grommet, made with log or other line; when finiſhed, they ſhould be well ſtretched or rounded up by a pricker or a marline-ſpike. Reef and head holes of large ſails have grommets of twelve-thread line, worked round with 18 to 21 ſtitches; ſmaller ſails have grommets of nine-thread line, with 16 to 18 ſtitches, or as many as ſhall cover the line, and ſmaller holes in proportion. The holes for marling the clues of ſails and the top-brims of topſails have grommets of log-line, and ſhould have from 9 to 11 ſtitches; twelve holes are worked in each cloth. Main courſes have marling holes from the clue to the lower bow line cringle up the leech, and from the clue to the firſt buntline cringle on the foot. Fore courſes have marling holes one eighth of the depth of the ſail up the leech, and from the clue to the firſt buntline cringle at the foot. Main and fore topſails have marling holes three feet each way from the clue and at the top-brims. Spritſails, mizen topſails, lower ſtayſails, main and fore top ſtayſails, and jibs, have marling holes two feet each way from the clues. All other ſails are ſewed home to the clues. Marling holes of courſes are at three fourths of the depth of the tablings at the clues from the rope, and thoſe of topſails are at half the depth of the tablings at the clues and top-brim from the rope."

The rope, which is ſewed on the edges of ſails to prevent their rending, and which is called *bolt-rope*, ſhould be well made of fine yarn, ſpun from the beſt Riga rhine hemp well topt, and ſewed on with good Engliſh-made twine of three threads, ſpun 200 fathom to the pound; the twine in the royal navy is dipped in a compoſition made with bees-wax, 4 lbs; hogs lard 5 lbs; and clear turpentine one pound; and in the merchant ſervice, in tar ſoftened with oil. They ſhould be ſtoved in a ſtove by the heat of a flue, and not in a baker's oven or a ſtove tub; and tarred in the beſt Stockholm tar. The flexibility of them ſhould be always conſidered, in taking in the ſlack, which muſt reſt on the judgment of the ſailmaker.

"Bolt-ropes of courſes, topſails, and all other ſails, ſhould be neatly ſewed on through every buntline of the rope; and, to avoid ſtretching, the rope muſt be kept tightly twiſted while ſewing on, and care taken that neither too much nor too little ſlack is taken in; they are to be croſs-ſtitched at the leeches every twelve inches in length; at every ſeam, and in the middle of every cloth at the foot, with three croſs-ſtitches: four croſs-ſtitches ſhould be taken at all beginnings and faſtenings off; the firſt ſtitch given twice, and the laſt three times. Small ſails have two croſs ſtitches at every ſeam, and three at every faſtening off.

Appendix.

"On main and fore courſes two inches ſlack cloth ſhould be allowed in the head and foot, and one inch and a half in the leeches, in every yard in length. Topſails are allowed 3 inches ſlack in every cloth in the foot, one inch and a half in every yard in the leech, and two inches in every cloth left open in the top-brim. Mizen courſes have two inches ſlack in every yard in the foremoſt leech, but none in the after leech or foot. Spritſail courſes have no ſlack cloth. Jibs have four inches ſlack in every yard in the ſtay, one inch in every cloth in the foot, and none in the leech. Stayſails have three inches ſlack in every yard in the ſtay, one inch in every cloth in the foot, but none in the leech. Topgallant ſails have two inches ſlack in every cloth in the foot, and one inch in every yard in the leech. Studding ſails have an inch and a half ſlack in every yard in goring leeches, but no ſlack in ſquare leeches, and one inch in every cloth in the head and foot." Appendix.

Theſe directions for ſailmaking, we truſt may be uſeful. They are indeed very general, but the limits preſcribed us will not permit of a more minute detail. The ſailmaker will find every inſtruction that he can want in the *Elements of Rigging and Seamanſhip*, a work which we therefore recommend to his attention.

SHI

Ship.

Ship's Form Gauge, an inſtrument recommended by Mr Hutchinſon as fit to aſcertain any alteration in the bottom of a ſhip, by its hogging or ſagging; and alſo to regulate the ſtowage of a ſhip.

"All ſhips (ſays he) of any conſequence are built with ſtaunchions fixed from the kelſon to the middle of all the lower-deck beams fore and aft, in order to ſupport them in their exact, regular height, as well as the whole frame of the ſhip in the regular form in which ſhe was built upon the ſtocks; yet notwithſtanding theſe ſtaunchions, it is proved from experience that our ſhips bottoms, hitherto, by the preſſure of water, and improper ſtowage, have generally been hogged upwards, or ſagged downwards, and moſt about the midſhip frame or main body of the ſhip, which is commonly about the fore part of the main hatchway; which naturally makes it the beſt place at which to fix the ſhip's form gauge, where either the hogging or ſagging of her bottom may be obſerved and ſeen ſooneſt and beſt, to regulate the ſtowage of heavy materials to the greateſt advantage, ſo as to keep her bottom nearly in the ſame form in which ſhe was built.

"The gauge I recommend is nothing more than a narrow plate of iron divided into inches and quarters like the ſlide of a carpenter's rule. Let this be fixed to the after ſide of the ſtaunchion now mentioned, with its upper end projecting two or three inches above the ſtaunchion; a groove being cut out for it in the after ſide of the lower-deck beam, and a mark being made (when the ſhip is on the ſtocks) at the part of the beam which correſponds to the o on the gauge. When the ſhip alters in her ſhape, the gauge will ſlide up and down in this groove, and the quantity of hogging or ſagging will be pointed out on the gauge by the mark on the beam. The ſtowage may then be ſo managed as to bring this mark to coincide again with the o, or to approach it as near as we ſee neceſſary."

Ship-Money, was an impoſition charged upon the ports, towns, cities, boroughs, and counties of this realm, in the reign of king Charles I. by writs, commonly called *ſhip-writs*, under the great ſeal of England, in the years 1635 and 1636, for the providing and furniſhing of certain ſhips for the king's ſervice, &c. which was declared to be contrary to the laws and ſtatutes of this realm, the *petition of right* and liberty of the ſubject, by ſtat. 17 Car. I. c. 14. See *Blackſtone's Commentaries*, vol. iv. p. 30.

Ship-Shape, according to the faſhion of a ſhip, or in the manner of an expert ſailor; as, The maſt is not rigged ſhip-ſhape; Trim your ſails ſhip-ſhape.

SHI

Ship.

Stowing and Trimming of Ships, the method of diſpoſing of the cargo in a proper and judicious manner in the hold of a ſhip.

A ſhip's ſailing, ſteering, ſtaying, and wearing, and being lively and comparatively eaſy at ſea in a ſtorm, depends greatly on the cargo, ballaſt, or other materials, being properly ſtowed, according to their weight and bulk, and the proportional dimenſions of the built of the ſhip, which may be made too crank or too ſtiff to paſs on the ocean with ſafety. Theſe things render this branch of knowledge of ſuch conſequence, that rules for it ought to be endeavoured after, if but to prevent, as much as poſſible, the danger of a ſhip overſetting at ſea, or being ſo labourſome as to roll away her maſts, &c. by being improperly ſtowed, which is often the caſe.

When a ſhip is new, it is prudent to conſult the builder, who may be ſuppoſed beſt acquainted with a ſhip of his own planning, and moſt likely to judge what her properties will be, to adviſe how the cargo or materials, according to the nature of them, ought to be diſpoſed of to advantage, ſo as to put her in the beſt ſailing trim; and at every favourable opportunity afterwards it will be proper to endeavour to find out her beſt trim by experiment.

Ships muſt differ in their form and proportional dimenſions; and to make them anſwer their different purpoſes, they will require different management in the ſtowage, which ought not to be left to mere chance, or done at random, as goods or materials happen to come to hand, which is too often the cauſe that ſuch improper ſtowage makes ſhips unfit for ſea: therefore the ſtowage ſhould be conſidered, planned, and contrived, according to the built and properties of the ſhip, which if they are not known ſhould be inquired after. If ſhe is narrow and high-built in proportion, ſo that ſhe will not ſhift herſelf without a great weight in the hold, it is a certain ſign ſuch a ſhip will require a great part of heavy goods, ballaſt, or materials, laid low in the hold, to make her ſtiff enough to bear ſufficient ſail without being in danger of overſetting. But if a ſhip be built broad and low in proportion, ſo that ſhe is ſtiff and will ſupport herſelf without any weight in the hold, ſuch a ſhip will require heavy goods, ballaſt, or materials, ſtowed higher up, to prevent her from being too ſtiff and labourſome at ſea, ſo as to endanger her maſts being rolled away, and the hull worked looſe and made leaky.

In order to help a ſhip's ſailing, that ſhe ſhould be lively and eaſy in her pitching and aſcending motions,

Ship. it ſhould be contrived by the ſtowage, that the principal and weightieſt part of the cargo or materials ſhould lie as near the main body of the ſhip, and as far from the extreme ends, fore and aft, as things will admit of. For it ſhould be conſidered, that the roomy part of our ſhips lengthwiſe forms a ſweep or curve near four times as long as they are broad; therefore thoſe roomy parts at and above the water's edge, which are made by a full harping and a broad tranſom to ſupport the ſhip ſteady and keep her from plunging into the ſea, and alſo by the entrance and run of the ſhip having little or no bearing body under for the preſſure of the water to ſupport them, of courſe ſhould not be ſtowed with heavy goods or materials, but all the neceſſary vacancies, broken ſtowage, or light goods, ſhould be at theſe extreme ends fore and aft; and in proportion as they are kept lighter by the ſtowage, the ſhip will be more lively to fall and riſe eaſy in great ſeas; and this will contribute greatly to her working and ſailing, and to prevent her from ſtraining and hogging; for which reaſon it is a wrong practice to leave ſuch a large vacancy in the main hatchway, as is uſual, to coil and work the cables, which ought to be in the fore or after hatchway, that the principal weight may be more eaſily ſtowed in the main body of the ſhip, above the flatteſt and loweſt floorings, where the preſſure of the water acts the more to ſupport it.

Machine for meaſuring a SHIP'S *Way.* We have already deſcribed a variety of machines or inſtruments which have been propoſed for this purpoſe under the article LOG. In this place, therefore, we ſhall confine ourſelves to the machine invented by Francis Hopkinſon, Eſq; Judge of the Admiralty in Pennſylvania.—After having ſhown the fallacies to which the common log, and alſo that particular kind of inſtrument invented by M. Saumarez, are liable, he proceeds to deſcribe his own machine as follows:

Tranſactions of the American Philoſophical Society, vol. ii. p. 160.

This machine, in its moſt ſimple form, is repreſented by fig. 5. Plate CCCCLIII. wherein A B is a ſtrong rod of iron moveable on the fulcrum C. D is a thin circular palate of braſs rivetted to the lower extremity of the rod. E an horizontal arm connected at one end with the top of the rod AB by a moveable joint F, and at the other end with the bottom of the index H, by a like moveable joint G. H is the index turning on its centre I, and travelling over the graduated arch K; and L is a ſtrong ſpring, bearing againſt the rod AB, and conſtantly counteracting the preſſure upon the palate D. The rod AB ſhould be applied cloſe to the cut-water or ſtem, and ſhould be of ſuch a length that the palate D may be no higher above the keel than is neceſſary to ſecure it from injury when the veſſel is aground, or ſails in ſhoal water. As the bow of the ſhip curves inward towards the keel M, the palate D will be thrown to a diſtance from the bottom of the veſſel, although the perpendicular rod to which it is annexed lies cloſe to the bow above; and therefore the palate will be more fairly acted upon. The arm E ſhould enter the bow ſomewhere near the hawſe hole, and lead to any convenient place in the forecaſtle, where a ſmooth board or plate may be fixed, having the index H, and graduated arch K, upon it.

It is evident from the figure, that as the ſhip is urged forward by the wind, the palate D will be preſſed upon by the reſiſting medium, with a greater or leſs force, according to the progreſſive motion of the ſhip; and this will operate upon the levers ſo as to immediately affect the index, making the leaſt increaſe or diminution of the ſhip's way viſible on the graduated arch; the ſpring L always counteracting the preſſure upon the palate, and bringing back the index, on any relaxation of the force impreſſed. Ship.

This machine is advantageouſly placed at the bow of the ſhip, where the current firſt begins, and acts fairly upon the palate, in preference to the ſtern, where the tumultuous cloſing of the waters cauſes a wake, viſible to a great diſtance. The palate D is ſunk nearly as low as the keel, that it may not be influenced by the heaping up of the water and the daſhing of the waves at and near the water line. The arch K is to aſcertain how many knots or miles ſhe would run in one hour at her then rate of ſailing. But the graduations on this arch muſt be unequal; becauſe the reſiſtance of the ſpring L will increaſe as it becomes more bent, ſo that the index will travel over a greater ſpace from one to five miles than from five to twelve. Laſtly, the palate, rod, ſpring, and all the metallic parts of the inſtrument, ſhould be covered with a ſtrong varniſh, to prevent ruſt from the corroſive quality of the ſalt water and ſea air.

This machine may be conſiderably improved as follows: Let the rod or ſpear AB (fig. 5.) be a round rod of iron or ſteel, and inſtead of moving on the fulcrum or joint, as at C, let it paſs through and turn freely in a ſocket, to which ſocket the moveable joint muſt be annexed, as repreſented in fig. 6. The rod muſt have a ſhoulder to bear on the upper edge of the ſocket, to prevent its ſlipping quite down. The rod muſt alſo paſs through a like ſocket at F, fig. 5. The joint of the lower ſocket muſt be fixed to the bow of the ſhip, and the upper joint or ſocket muſt be connected with the horizontal arm E. On the top of the uppermoſt ſocket let there be a ſmall circular plate, bearing the 32 points of the mariner's compaſs; and let the top of the rod AB come through the centre of this plate, ſo as to carry a ſmall index upon it, as is repreſented in fig. 7. This ſmall index muſt be fixed to the top of the rod on a ſquare, ſo that by turning the index round the plate, the rod may alſo turn in the ſockets, and of courſe carry the palate D round with it; the little index always pointing in a direction with the face of the palate. The ſmall compaſs plate ſhould not be faſtened to the top of the ſocket, but only fitted tightly on, that it may be moveable at pleaſure. Suppoſe then the intended port to bear S. W. from the place of departure, the palate muſt be turned on the ſocket till the ſouth-weſt point thereon looks directly to the ſhip's bow; ſo that the ſouth-weſt and north-eaſt line on the compaſs plate may be preciſely parallel with the ſhip's keel, and in this poſition the plate muſt remain during the whole voyage. Suppoſe, then, the ſhip to be ſailing in the direct courſe of her intended voyage, with her bowſprit pointing ſouth-weſt. Let the little index be brought to the ſouth-weſt point on the compaſs plate, and the palate D will neceſſarily preſent its broad face toward the port of deſtination; and this it muſt always be made to do, be the ſhip's courſe what it may. If, on account of unfavourable winds, the ſhip is obliged to deviate from her intended courſe, the little index muſt be moved ſo many points from the ſouth-weſt

Ship. line of the compaſs plate as the compaſs in the binnacle ſhall ſhow that ſhe deviates from her true courſe; ſo that in whatever direction the ſhip ſhall ſail, the palate D will always look full to the ſouth-weſt point of the horizon, or towards the port of deſtination, and conſequently will preſent only an oblique ſurface to the reſiſting medium, more or leſs oblique as the ſhip deviates more or leſs from the true courſe of her voyage. As, therefore, the reſiſtance of the water will operate leſs upon the palate in an oblique than in a direct poſition, in exact proportion to its obliquity, the index H will not ſhow how many knots the veſſel runs in her then courſe, but will indicate how many ſhe gains in the direct line of her intended voyage.—Thus, in fig. 9. if the ſhip's courſe lies in the direction of the line AB, but ſhe can ſail by the wind no nearer than AC; ſuppoſe, then, her progreſſive motion ſuch as to perform AC equal to five knots or miles in an hour, yet the index H will only point to four knots on the graduated arch, becauſe ſhe gains no more than at that rate on the true line of her voyage, viz. from A to B. Thus will the difference between her real motion and that pointed out by the index be always in proportion to her deviation from her intended port, until ſhe ſails in a line at right angles therewith, as AD; in which caſe the palate would preſent only a thin ſharp edge to the reſiſting medium, the preſſure of which ſhould not be ſufficient to overcome the friction of the machine and the bearing of the ſpring L. So that at whatever rate the ſhip may ſail on that line, yet the index will not be affected, ſhowing that ſhe gains nothing on her true courſe. In this caſe, and alſo when the veſſel is not under way, the action of the ſpring L ſhould cauſe the index to point at O, as repreſented by the dotted lines in fig. 5. and 8.

As the truth of this inſtrument muſt depend on the equal preſſure of the reſiſting medium upon the palate D, according to the ſhip's velocity, and the proportionable action of the ſpring L, there ſhould be a pin or ſcrew at the joints C and F, ſo that the rod may be readily unſhipped and taken in, in order to clean the palate from any foulneſs it may contract, which would greatly increaſe its operation on the index H, and thereby render the graduated arch falſe and uncertain.

Further, the ſpring L may be expoſed too much to injury from the ſalt water, if fixed on the outſide of the ſhip's bow. To remedy this, it may be brought under cover, by conſtructing the machine as repreſented by fig. 8. where AB is the rod, C the fulcrum or centre of its motion, D the palate, E the horizontal arm leading through a ſmall hole into the forecaſtle; M is a ſtrong chain faſtened at one end to the arm E, and at the other to a rim or barrel on the wheel G, which by means of its teeth gives motion to the ſemicircle I and index H. The ſpring L is ſpiral, and encloſed in a box or barrel, like the main ſpring of a watch. A ſmall chain is fixed to, and paſſing round the barrel, is faſtened by the other end to the fuzee W. This fuzee is connected by its teeth with the wheel G, and counteracts the motion of the palate D. N, N, are the two ſockets through which the rod AB paſſes, and in which it is turned round by means of the little index R. S is the ſmall compaſs plate, moveable on the top of the upper ſocket N. The plate S hath an upright rim round its edge, cut into teeth or notches, ſo that when the index R is a little raiſed up, in order to bring it round to any intended point, it may fall into one of theſe notches, and be detained there; otherwiſe the preſſure of the water will force the palate D from its oblique poſition, and turn the rod and index round to the direction in which the ſhip ſhall be then ſailing.—Should it be apprehended that the palate D, being placed ſo far forward, may affect the ſhip's ſteerage, or obſtruct her rate of ſailing, it ſhould be conſidered that a very ſmall plate will be ſufficient to work the machine, as one of three or four inches in diameter would probably be ſufficient, and yet not large enough to have any ſenſible effect on the helm or ſhip's way. Ship.

The greateſt difficulty, perhaps, will be in graduating the arch K, (if the machine is conſtructed as in fig. 5.); the unequal diviſions of which can only be aſcertained by actual experiment on board of each ſhip reſpectively, inaſmuch as the accuracy of theſe graduations will depend on three circumſtances, viz. the poſition of the fulcrum C with reſpect to the length of the rod, the ſize of the palate D, and the ſtrength or bearing of the ſpring L. When theſe graduations, however, are once aſcertained for the machine on board of any one veſſel, they will not want any future alterations, provided the palate D be kept clean, and the ſpring L retains its elaſticity.

But the unequal diviſions of the graduated arch will be unneceſſary, if the machine is conſtructed as in fig. 8.; for as the chain goes round the barrel L, and then winds through the ſpiral channel of the fuzee W, the force of the main ſpring muſt operate equally, or nearly ſo, in all poſitions of the index, and conſequently the diviſions of the arch K may in ſuch caſe be equal.

After all, it is not expected that a ſhip's longitude can be determined to a mathematical certainty by this inſtrument. The irregular motions and impulſes to which a ſhip is continually expoſed, make ſuch an accuracy unattainable perhaps by any machinery: But if it ſhould be found, as we flatter ourſelves it will on fair experiment, that it anſwers the purpoſe much better than the common log, it may be conſidered as an acquiſition to the art of navigation.

It ſhould be obſerved, that in aſcertaining a ſhip's longitude by a time-piece, this great inconvenience occurs, that a ſmall and trifling miſtake in the time makes a very great and dangerous error in the diſtance run: Whereas the errors of this machine will operate no farther than their real amount; which can never be great or dangerous, if corrected by the uſual obſervations made by mariners for correcting the common log.

A like machine, made in its ſimple form (as at fig. 5.), ſo conſtructed as to ſhip and unſhip, might occaſionally be applied alongſide about midſhips, in order to aſcertain the leeway; which, if rightly ſhown, will give the ſhip's preciſe longitude. As to ſea currents, this and all other machines hitherto invented muſt be ſubject to their influence; and proper allowances muſt be made according to the ſkill and knowledge of the navigator.

Laſtly, ſome diſcretion will be neceſſary in taking obſervations from the machine to be entered on the log-book: that is, the moſt favourable and equitable moment ſhould be choſen for the obſervation; not whilſt the ſhip is rapidly deſcending the declivity of a wave, or is ſuddenly checked by a ſtroke of the ſea, or is in the very act of plunging. In all caſes, periods may be found in which a ſhip proceeds with a true average velocity;

Shiraus || Shoad.

velocity; to diſcover which, a little experience and attention will lead the ſkilful mariner (A).

SHIRAUZ. See SCHIRAS.

SHIRE, is a Saxon word ſignifying a diviſion; but a county, *comitatus*, of the ſame import, is plainly derived from *comes*, "the count of the Franks;" that is, the earl or alderman (as the Saxons called him) of the ſhire, to whom the government of it was entruſted. This he uſually exerciſed by his deputy, ſtill called in Latin *vice-comes*, and in Engliſh the *ſheriff*, *ſhrieve*, or *ſhire reeve*, ſignifying the "officer of the ſhire;" upon whom, in proceſs of time, the civil adminiſtration of it totally devolved. In ſome counties there is an intermediate diviſion between the ſhire and the hundred; as lathes in Kent and rapes in Suſſex, each of them containing about three or four hundreds apiece. Theſe had formerly their lathe-reeves and rape-reeves, acting in ſubordination to the ſhire-reeve. Where a county is divided into three of theſe intermediate juriſdictions, they are called *trithings*, which were anciently governed by a trithing reeve. Theſe trithings ſtill ſubſiſt in the large county of York, where, by an eaſy corruption, they are denominated *ridings*; the north, the eaſt, and the weſt riding.

SHIRL, or COCKLE, in mineralogy. See COCKLE.

SHIRT, a looſe garment, commonly of linen, worn next the body.—Some doubt the propriety of changing the linen when a perſon is ſick. Clean linen promotes perſpiration; and it may be renewed as often as the patient pleaſes, whether the diſorder be of the acute or the chronical kind. Except during a criſis in fevers, whilſt the patient is in a ſweat, a change of linen, if well dried and warmed, may be daily uſed.

Shirts were not worn by Jews, Greeks, or Romans, but their place was ſupplied by thin *tunicæ* of wool. The want of linen among the ancients made frequent waſhings and ablutions neceſſary.

SHIVER. See SCHISTUS and SHALE.

SHIVERS, in the ſea-language, names given to the little rollers, or round wheels of pulleys.

SHOAD, among miners, denotes a train of metalline ſtones, ſerving to direct them in the diſcovery of mines.

SHOAD-Stones, a term uſed by the miners of Cornwall and other parts of this kingdom, to expreſs ſuch looſe maſſes of ſtone as are uſually found about the entrances into mines, ſometimes running in a ſtraight courſe from the load or vein of ore to the ſurface of the earth.

Theſe are ſtones of the common kinds, appearing to have been pieces broken from the ſtrata or larger maſſes; but they uſually contain mundic, or marcaſitic matter, and more or leſs of the ore to be found in the mine. They appear to have been at ſome time rolled about in water, their corners being broken off, and their ſurface ſmoothed and rounded.

The antimony mines in Cornwall are always eaſily diſcovered by the ſhoad-ſtones, theſe uſually lying up to the ſurface, or very nearly ſo; and the matter of the ſtone being a white ſpar, or debaſed cryſtal, in which the native colour of the ore, which is a ſhining bluiſh black, eaſily diſcovers itſelf in ſtreaks and threads. Shoad || Shoes.

Shoad-ſtones are of ſo many kinds, and of ſuch various appearances, that it is not eaſy to deſcribe or know them: but the miners, to whom they are of greateſt uſe in the tracing or ſearching after new mines, diſtinguiſh them from other ſtones by their weight; for if very ponderous, though they look ever ſo much like common ſtones, there is great reaſon to ſuſpect that they contain ſome metal. Another mark of them is their being ſpongy and porous; this is a ſign of eſpecial uſe in the tin countries; for the tin ſhoad-ſtones are often ſo porous and ſpongy, that they reſemble large bodies thoroughly calcined. There are many other appearances of tin ſhoads, the very hardeſt and firmeſt ſtones often containing this metal.

When the miners, in tracing a ſhoad up hill, meet with ſuch odd ſtones and earths that they know not well what to make of them, they have recourſe to vanning, that is, they calcine and powder the ſtone, clay, or whatever elſe is ſuppoſed to contain the metal; and then waſhing it in an inſtrument, prepared for that purpoſe, and called a *vanning ſhovel*, they find the earthy matter waſhed away, and of the remainder, the ſtony or gravelly matter lies behind, and the metalline matter at the point of the ſhovel. If the perſon who performs this operation has any judgment, he eaſily diſcovers not only what the metal is that is contained in the ſhoad, but alſo will make a very probable gueſs at what quantity the mine is likely to yield of it in proportion to the ore.

SHOAL, in the ſea-language, denotes a place where the water is ſhallow; and likewiſe a great quantity of fiſhes, ſuch as *a ſhoal of herrings*.

SHOCK, in electricity. The effect of the exploſion of a charged body, that is, the diſcharge of its electricity on any other body, is called the *electric ſhock*.

SHOE, a covering for the foot, uſually of leather.

SHOES, among the Jews, were made of leather, linen, ruſh, or wood; thoſe of ſoldiers were ſometimes of braſs or iron. They were tied with thongs which paſſed under the ſoles of the feet. To put off their ſhoes was an act of veneration; it was alſo a ſign of mourning and humiliation: to bear one's ſhoes, or to untie the latchets of them, was conſidered as the meaneſt ſervice.

Among the Greeks ſhoes of various kinds were uſed. Sandals were worn by women of diſtinction. The Lacedemonians wore red ſhoes. The Grecian ſhoes generally reached to the middle of the leg. The Romans uſed two kinds of ſhoes; the *calceus*, which covered the whole foot ſomewhat like our ſhoes, and was tied above with latchets or ſtrings; and the *ſolea* or ſlipper, which covered only the ſole of the foot, and was faſtened with leathern thongs. The calceus was always worn along

(A) An ingenious mechanic would probably conſtruct this machine to better advantage in many reſpects. The author only meant to ſuggeſt the principle; experiment alone can point out the beſt method of applying it. He is ſenſible of at leaſt of one deficiency, viz. that the little index R, fig. 4. will not be ſtrong enough to retain the palate D in an oblique poſition when the ſhip is ſailing by the wind; more eſpecially as the compaſs plate S, in whoſe notched rim the index R is to fall, is not fixed to, but only fitted tight on the ſocket N. Many means, however, might be contrived to remedy this inconvenience.

Shoes. along with the *toga* when a perſon went abroad: ſlippers were put on during a journey and at feaſts, but it was reckoned effeminate to appear in public with them. Black ſhoes were worn by the citizens of ordinary rank, and white ones by the women. Red ſhoes were ſometimes worn by the ladies, and purple ones by the coxcombs of the other ſex. Red ſhoes were put on by the chief magiſtrates of Rome on days of ceremony and triumphs. The ſhoes of ſenators, patricians, and their children, had a creſcent upon them which ſerved for a buckle; theſe were called *calcei lunati*. Slaves wore no ſhoes; hence they were called *cretati* from their dirty feet. Phocion alſo and Cato Uticenſis went without ſhoes. The toes of the Roman ſhoes were turned up in the point; hence they were called *calcei roſtrati*, *repandi*, &c.

In the 9th and 10th centuries the greateſt princes of Europe wore wooden ſhoes, or the upper part of leather and the ſole of wood. In the reign of William Rufus, a great beau, Robert, ſurnamed *the horned*, uſed ſhoes with long ſharp points, ſtuffed with tow, and twiſted like a ram's horn. It is ſaid the clergy, being highly offended, declaimed againſt the long-pointed ſhoes with great vehemence. The points, however, continued to increaſe till, in the reign of Richard II. they were of ſo enormous a length that they were tied to the knees with chains ſometimes of gold, ſometimes of ſilver. The upper parts of theſe ſhoes in Chaucer's time were cut in imitation of a church window. The long-pointed ſhoes were called *crackowes*, and continued in faſhion for three centuries in ſpite of the bulls of popes, the decrees of councils, and the declamations of the clergy. At length the parliament of England interpoſed by an act A. D. 1463, prohibiting the uſe of ſhoes or boots with pikes exceeding two inches in length, and prohibiting all ſhoemakers from making ſhoes or boots with longer pikes under ſevere penalties. But even this was not ſufficient: it was neceſſary to denounce the dreadful ſentence of excommunication againſt all who wore ſhoes or boots with points longer than two inches. The preſent faſhion of ſhoes was introduced in 1633, but the buckle was not uſed till 1670.

In Norway they uſe ſhoes of a particular conſtruction, conſiſting of two pieces, and without heels; in which the upper leather fits cloſe to the foot, the ſole being joined to it by many plaits or folds.

The ſhoes or ſlippers of the Japaneſe, as we are informed by Profeſſor Thunberg, are made of rice-ſtraw woven, but ſometimes for people of diſtinction of fine ſlips of ratan. The ſhoe conſiſts of a ſole, without upper leather or hind-piece; forwards it is croſſed by a ſtrap, of the thickneſs of one's finger, which is lined with linen; from the tip of the ſhoe to the ſtrap a cylindrical ſtring is carried, which paſſes between the great and ſecond toe, and keeps the ſhoe faſt on the foot. As theſe ſhoes have no hind-piece, they make a noiſe, when people walk in them like ſlippers. When the Japaneſe travel, their ſhoes are furniſhed with three ſtrings made of twiſted ſtraw, with which they are tied to the legs and feet, to prevent them from falling off. Some people carry one or more pairs of ſhoes with them on their journeys, in order to put on new, when the old ones are worn out. When it rains, or the roads are very dirty, theſe ſhoes are ſoon wetted through, and one continually ſees a great number of worn-out ſhoes lying on the roads, eſpecially near the brooks, where travellers have changed their ſhoes after waſhing their feet. Inſtead of theſe, in rainy or dirty weather they wear high wooden clogs, which underneath are hollowed out in the middle, and at top have a band acroſs like a ſtirrup, and a ſtring for the great toe; ſo that they can walk without ſoiling their feet. Some of them have their ſtraw ſhoes faſtened to theſe wooden clogs. The Japaneſe never enter their houſes with their ſhoes on; but leave them in the entry, or place them on the bench near the door, and thus are always barefooted in their houſes, ſo as not to dirty their neat mats. During the time that the Dutch live at Japan, when they are ſometimes under an obligation of paying viſits at the houſes of the Japaneſe, their own rooms at the factory being likewiſe covered with mats of this kind, they wear, inſtead of the uſual ſhoes, red, green, or black ſlippers, which on entering the houſe they pull off: however, they have ſtockings on, and ſhoes made of cotton ſtuff with buckles in them, which ſhoes are made at Japan, and can be waſhed whenever they are dirty. Some have them of black ſattin, in order to avoid waſhing them. Shoes, Shooting.

Shoe of an Anchor, a ſmall block of wood, convex on the back, and having a ſmall hole, ſufficient to contain the point of the anchor fluke, on the foreſide. It is uſed to prevent the anchor from tearing or wounding the planks on the ſhip's bow, when aſcending or deſcending; for which purpoſe the ſhoe ſlides up and down along the bow between the fluke of the anchor and the planks, as being preſſed cloſe to the latter by the weight of the former.

To Shoe an Anchor, is to cover the flukes with a broad triangular piece of plank, whoſe area or ſuperficies is much larger than that of the flukes. It is intended to give the anchor a ſtronger and ſurer hold of the bottom in very ſoft and oozy ground.

Horſe-Shoe. See Farriery, Sect. 47.

SHOOTING, in the military art. See Artillery, Gunnery, and Projectiles.

Shooting, in ſportſmanſhip, the killing of game by the gun, with or without the help of dogs. 1 Shooting in ſportſmanſhip.

Under this article we ſhall lay down all the rules which are neceſſary to be obſerved in order to render one accompliſhed and ſucceſsful in the art of ſhooting.

The firſt thing which the ſportſman ought to attend to is the choice of his fowling-piece. Conveniency requires that the barrel be as light as poſſible, at the ſame time it ought to poſſeſs that degree of ſtrength which will make it not liable to burſt. Experience has proved, that a thin and light barrel, which is of equal thickneſs in every part of its circumference, is much leſs liable to burſt than one which is conſiderably thicker and heavier, but which, from being badly filed or bored, is of unequal ſtrength in different places. 2 Directions for chooſing a fowling-piece.

It is alſo of importance to determine of what length the barrel ought to be, in order to acquire that range which the ſportſman has occaſion for. On this ſubject we have received the following information from an experienced ſportſman. We have, at different times, compared barrels of all the intermediate lengths between 28 and 40 inches, and of nearly the ſame caliber, that is to ſay, from 22 to 26; and theſe trials were

7 made

Shooting. made both by firing the pieces from the ſhoulder, and from a firm block, at an equal diſtance, and with equal weights of the ſame powder and of the ſame ſhot.

To avoid every poſſibility of error, the quires of paper at which we fired were fixed againſt planks inſtead of being placed againſt the wall. From theſe trials frequently repeated, we found that the ſhot pierced an equal number of ſheets, whether it was fired from a barrel of 28, 30, 32, 34, 36, 38, or 40, inches in length. Nay more, we have compared two barrels of the ſame caliber, but one of them 33, and the other 66 inches long, by repeatedly firing them in the ſame manner as the others, at different diſtances, from 45 to 100 paces, and the reſults have always been the ſame, *i. e.* the barrel of 33 inches drove its ſhot through as many ſheets of paper as that of 66 did. The concluſion from all this is, that the difference of 10 inches in the length of the barrel, which ſeems to be more than is ever inſiſted upon among ſportſmen, produces no ſenſible difference in the range of the piece; and therefore, that every one may pleaſe himſelf in the length of his barrel, without either detriment or advantage to the range.

It may appear as an objection to this, that a duck-gun which is five or ſix feet long kills at a greater diſtance than a fowling-piece; but this is not owing to its length, but to its greater weight and thickneſs, which give it ſuch additional ſtrength, that the ſhot may be increaſed, and the charge of powder doubled, trebled,

3 Proper length of the barrel. and even quadrupled. But a barrel of five or ſix feet length would be very inconvenient for fowling. Thoſe who conſult the appearance of the piece, lightneſs, and the eaſe with which it is managed, will find that a barrel from 32 to 38 inches will anſwer beſt.

4 Caliber. The next thing to be conſidered is, of what dimenſions the caliber or bore of a fowling-piece ought to be. This matter has been ſubjected to experiment, and it has been found, that a barrel of 22 or 24, which is the largeſt caliber uſually employed in fowling-pieces, throws its ſhot as cloſely as one of the ſmalleſt caliber, viz. of 30 or 32 (A).

5 Length and form of the ſtock. As to the length and form of the ſtock, it may be laid down as a principle, that a long ſtock is preferable to a ſhort one, and at the ſame time rather more bent than uſual; for a long ſtock ſits firmer to the ſhoulder than a ſhort one, and particularly ſo when the ſhooter is accuſtomed to place his left hand, which principally ſupports the piece, near to the entrance of the ramrod into the ſtock.

It is certain, however, that the ſtock may be ſo formed as to be better ſuited to one man than another. For a tall, long-armed man, the ſtock of a gun ſhould be longer than for one of a leſs ſtature and ſhorter arm. That a ſtraight ſtock is proper for him who has high ſhoulders and a ſhort neck; for, if it be much bent, it would be very difficult for him, eſpecially in the quick motion required in ſhooting at a flying or running object, to place the butt of the gun-ſtock firmly to the ſhoulder, the upper part alone would in general be fixed; which would not only raiſe the muzzle, and conſequently ſhoot high, but make the recoil much more ſenſibly felt, than if the whole end of the ſtock were firmly placed on his ſhoulder. Beſides, ſuppoſing the ſhooter to bring the butt home to his ſhoulder, he would ſcarcely be able to level his piece at the object. On the contrary, a man with low ſhoulders, and a long neck, requires a ſtock much bent; for if it is ſtraight, he will, in the act of lowering his head to that place of the ſtock at which his cheek ſhould reſt in taking aim, feel a conſtraint which he never experiences, when by the effect of the proper degree of bent, the ſtock lends him ſome aſſiſtance, and, as it were, meets his aim half way.

Having now deſcribed the fowling-piece which has been found to anſwer beſt, it will next be proper to give ſome inſtructions for the choice of gunpowder, ſhot, and wadding.

6 Beſt gunpowder. The various kinds of gunpowder are well known; but, in the opinion of ſome experienced ſportſmen, Hervey's battle-powder is the beſt. Thoſe who wiſh to examine the ſtrength of powder, may determine it by drying ſome of it very well, and then trying how many ſheets of paper it will drive the ſhot through, at the diſtance of 10 or 12 yards. In this trial we ſhould be careful to employ the ſame ſized ſhot in each experiment, the quantity both of the ſhot and the powder being regulated by exact weight; otherwiſe we cannot, even in this experiment, arrive to any certainty in comparing the ſtrength of different powders, or of the ſame powder at different times.

7 To be kept dry. Powder ought to be kept very dry, for every degree of moiſture injures it; and if conſiderable, the ſaltpetre is diſſolved, and the intimate combination of the ſeveral ingredients is entirely deſtroyed. It is obſerved, that after firing with damp powder the piece becomes very foul, which ſeems to ariſe from the diminution of the activity of the fire in the exploſion. Flaſks of copper or tin are much better for keeping powder in than thoſe made of leather, or than ſmall caſks. Their necks ought to be ſmall and well ſtopped with cork.

8 Size of ſhot. The *patent milled ſhot* is now very generally uſed, and is reckoned ſuperior to any other. The ſize of the ſhot muſt vary according to the particuliar ſpecies of game which is the object of the ſportſman's purſuit, as well as be adapted to the ſeaſon. In the firſt month of partridge ſhooting, N° 1. is moſt proper; for ſince at this time the birds ſpring near at hand, and we ſeldom fire at more than the diſtance of 40 paces, if the ſhooter takes his aim but tolerably well, it is almoſt impoſſible for a bird at this diſtance to eſcape in the circle which the ſhot forms.

As hares ſit cloſer, and are thinly covered with fur at this ſeaſon, they may eaſily be killed with this ſhot at 30 or 35 paces. N° 1. is equally proper for ſhooting ſnipes or quails. About the beginning of October, when the partridges are ſtronger, N° 3. is the moſt proper ſhot to be uſed. Many ſportſmen uſe no other during the whole ſeaſon. The directions which have now been given refer only to the patent ſhot.

We ſhall now ſubjoin a table, which will ſhow at one view the number of pellets compoſing an ounce weight of each ſort of ſhot, the patent and the common, beginning with the ſmalleſt ſize.

PATENT

(A) In ſpeaking of the ſize of the caliber, we mean by 22 or 24, that ſo many balls exactly fitting it weigh juſt one pound; and every caliber is marked in the ſame way.

Shooting.

PATENT SHOT.

N° 8.	1 ounce	- -	620
7	id.	- -	480
× (B)	id.	- -	300
1	id.	- -	220
2	id.	- -	180
3	id.	- - -	157
4	id.	- -	105
5	id.	- -	83

COMMON SHOT.

N° 7.	1 ounce	- -	350
6	id.	- - -	260
5	id.	- -	235
4	id.	- -	190
3	id.	- -	140
2	id.	- -	110
1	id.	- -	95

9 Proportion of powder and ſhot in the charge.

For a fowling-piece of a common caliber, which is from 24 to 30 balls to the pound weight, a dram and a quarter, or at moſt a dram and a half, of good powder; and an ounce, or an ounce and a quarter of ſhot, is ſufficient. But when ſhot of a larger ſize is uſed, ſuch as N° 5. the charge of ſhot may be increaſed one-fourth, for the purpoſe of counterbalancing in ſome degree what the ſize of the ſhot loſes in the number of pellets, and alſo to enable it to garni the more. For this purpoſe the ſportſman will find a meaſure marked with the proper gauges very convenient to him. An inſtrument of this nature has been made by an ingenious artiſt of London, Egg, of the Haymarket.

A conſequence of overloading with ſhot, is the powder has not ſufficient ſtrength to throw it to its proper diſtance; for if the object fired at be diſtant, one-half of the pellets compoſing the charge, by their too great quantity and weight, will ſtrike againſt each other, and fall by the way; and thoſe which reach the mark will have ſmall force, and will produce but little or no effect.

10 Wadding.

The uſe of the *wadding* is to carry the ſhot in a body to a certain diſtance from the muzzle of the piece. It ought to be of ſoft and pliable materials. The beſt kind of wadding, in the opinion of an experienced fowler, is a piece of an old hat; but this cannot be obtained in ſufficient quantity. Next to it nothing is better than ſoft brown paper, which combines ſuppleneſs with conſiſtence, moulds itſelf to the barrel, and never falls to the ground within 12 or 15 paces from the muzzle of the piece. Tow anſwers very well, and cork has been extolled for poſſeſſing the peculiar virtue of increaſing the range and cloſeneſs of the ſhot.

The wadding ought to be quite cloſe in the barrel, but not rammed too hard; for if it be rammed too cloſe, or be of a rigid ſubſtance, the piece will recoil, and the ſhot will ſpread too much. On the other hand, if the wadding be very looſe, or is compoſed of too ſoft materials, ſuch as wool or cotton, the diſcharge will not poſſeſs proper force.

11 Powder and ſhot to be ſlightly rammed down.

In loading a piece, the powder ought to be ſlightly rammed down by only preſſing the ramrod two or three times on the wadding, and not by drawing up the ramrod and then returning it into the barrel with a jerk of the arm ſeveral times. For when the powder is violently compreſſed, ſome of the grains muſt be bruiſed, which will prevent the exploſion from being quick, and will ſpread the ſhot too wide. In pouring the powder into the barrel, the meaſure ought to be held ſo as that the powder may fall moſt readily to the bottom. That no grains may adhere to the ſides of the barrel, the butt-end of the piece may be ſtruck againſt the ground. The ſhot ought never to be rammed down with force: it is ſufficient to ſtrike the butt-end of the gun againſt the ground as before. Then the wadding is to be put down gently. A ſportſman ought never to carry his gun under his arm with the muzzle inclined downwards, for this practice looſens the wadding and charge too much.

12 Directions for loading and firing.

Immediately after the piece is fired it ought to be reloaded; for while the barrel is ſtill warm, there is no danger of any moiſture lodging in it to hinder the powder from falling to the bottom. As it is found that the coldneſs of the barrel, and perhaps the moiſture condenſed in it, diminiſhes the force of the powder in the firſt ſhot; it is proper to fire off a little powder before the piece is loaded. Some prime before loading, but this is not proper unleſs the touch-hole be very large. After every diſcharge the touch-hole ought to be pricked, or a ſmall feather may be inſerted to clear away any humidity or foulneſs that has been contracted.

The ſportſman having loaded his piece, muſt next prepare to fire. For this purpoſe he ought to place his hand near the entrance of the ramrod, and at the ſame time graſp the barrel firmly. The muzzle ſhould be a little elevated, for it is more uſual to ſhoot low than high. This direction ought particularly to be attended to when the object is a little diſtant; becauſe ſhot as well as ball only moves a certain diſtance point blank, when it begins to deſcribe the curve of the parabola.

13 Diſtance at which the ſportſman ought to kill.

Practice ſoon teaches the ſportſman the proper diſtance at which he ſhould ſhoot. The diſtance at which he ought infallibly to kill any kind of game with patent ſhot, N° 3 provided the aim be well taken, is from 25 to 35 paces for the footed, and from 40 to 45 paces for the winged, game. Beyond this diſtance even to 50 or 55 paces, both partridges and hares are ſometimes killed; but in general the hares are only ſlightly wounded, and carry away the ſhot; and the partridges at that diſtance preſent ſo ſmall a ſurface, that they frequently eſcape untouched between the ſpaces of the circle. Yet it does not follow that a partridge may not be killed with N° 3 patent ſhot at 60 and even 70 paces diſtance, but then theſe ſhots are very rare.

14 How the aim is to be taken.

In ſhooting at a bird flying, or a hare running acroſs, it is neceſſary to take aim before the object in proportion to its diſtance at the time of firing. If a partridge flies acroſs at the diſtance of 30 or 35 paces, it will be ſufficient to aim at the head, or at moſt but a ſmall ſpace before it. If it be 50, 60, or 70 paces diſtant, it is then requiſite to aim at leaſt half a foot before the head. The ſame practice ought to be obſerved in ſhooting at a hare, rabbit, or fox, when running in a croſs direction; at the ſame time making due allowance for

(B) The reader will obſerve, that the patent ſhot has no N° 6. the × being ſubſtituted in its place, and that the numbers do not follow each other in the order of progreſſion: the reaſon of this we cannot aſſign.

Shooting for the diſtance and ſwiftneſs of the pace. Another thing to be attended to is, that the ſhooter ought not involuntarily to ſtop the motion of the arms at the moment of pulling the trigger; for the inſtant the hand ſtops in order to fire, however inconſiderable the time be, the bird gets beyond the line of aim, and the ſhot will miſs it. A ſportſman ought therefore to accuſtom his hand while he is taking aim to follow the object. When a hare runs in a ſtraight line from the ſhooter, he ſhould take his aim between the ears, otherwiſe he will run the hazard either of miſſing, or at leaſt not of killing dead, or as it is ſometimes called *clean*.

15 Every part of the piece to be kept clean and dry.

A fowling-piece ſhould not be fired more than 20 or 25 times without being waſhed; a barrel when foul neither ſhoots ſo ready, nor carries the ſhot ſo far as when clean. The flint, pan, and hammer, ſhould be well wiped after each ſhot; this contributes greatly to make the piece go off quick, but then it ſhould be done with ſuch expedition, that the barrel may be reloaded whilſt warm, for the reaſons we have before advanced. The flint ſhould be frequently changed, without waiting until it miſſes fire, before a new one is put in. Fifteen or eighteen ſhots, therefore, ſhould only be fired with the ſame flint; the expence is too trifling to be regarded, and by changing it thus often much vexation will be prevented.

A gun alſo ſhould never be fired with the prime of the preceding day; it may happen that an old priming will ſometimes go off well, but it will more frequently contract moiſture and fuze in the firing; then the object will moſt probably be miſſed, and that becauſe the piece was not freſh primed.

16 When and how game's to be ſought for.

For the information of the young ſportſman we ſhall add a few more general directions. In warm weather he ought to ſeek for game in plains and open grounds, and in cold weather he may ſearch little hills expoſed to the ſun, along hedges among heath, in ſtubbles, and in paſtures where there is much furze and fern. The morning is the beſt time of the day, before the dew is exhaled, and before the game has been diſturbed. The colour of the ſhooters dreſs ought to be the ſame with that of the fields and trees; in ſummer it ought to be green, in winter a dark grey. He ought to hunt as much as poſſible with the wind, not only to prevent the game from perceiving the approach of him and his dog, but alſo to enable the dog to ſcent the game at a greater diſtance.

He ſhould never be diſcouraged from hunting and ranging the ſame ground over and over again, eſpecially in places covered with heath, brambles, high graſs, or young coppice wood. A hare or rabbit will frequently ſuffer him to paſs ſeveral times within a few yards of its form without getting up. He ſhould be ſtill more patient when he has marked partridges into ſuch places, for it often happens, that after the birds have been ſprung many times, they lie ſo dead that they will ſuffer him almoſt to tread upon them before they will riſe. Pheaſants, quails, and woodcocks do the ſame.

He ought to look carefully about him, never paſſing a buſh or tuft of graſs without examination; but he ought never to ſtrike them with the muzzle of his gun for it will looſen his wadding. He who patiently beats and ranges his ground over again, without being diſcouraged, will always kill the greateſt quantity of game; and if he is ſhooting in company, he will find game where others have paſſed without diſcovering any. Shooting.

When he has fired he ſhould call in his dog, that he may not have the mortification to ſee game riſe which he cannot ſhoot. When he has killed a bird, inſtead of being anxious about picking it up, he ought to follow the reſt of the covey with his eye till he ſee them ſettle.

17 Dogs fit for ſport.

Three ſpecies of dogs are capable of receiving the proper inſtruction, and of being trained. Theſe are the ſmooth pointer, the ſpaniel, and the rough pointer. The laſt is a dog with long curled hair, and ſeems to be a mixed breed of the water-dog and the ſpaniel. The ſmooth pointer is active and lively enough in his range, but in general is proper only for an open country.

The greateſt part of theſe dogs are afraid of water, brambles, and thickets; but the ſpaniel and the rough pointer are eaſily taught to take the water, even in cold weather, and to range the woods and rough places as well as the plain. Greater dependence may therefore be had on theſe two laſt ſpecies of dogs than on the ſmooth pointer.

18 Directions for training a pointer,

The education of a pointer may commence when he is only five or ſix months old. The only leſſons which he can be taught at this time are to *fetch* and *carry* any thing when deſired; to come in when he runs far off, and to go behind when he returns; uſing, in the one caſe, the words *here, come in*, and in the other *back* or *behind*. It is alſo neceſſary at this period to accuſtom him to be tied up in the kennel or ſtable; but he ought not at firſt to be tied too long. He ſhould be let looſe in the morning, and faſtened again in the evening. When a dog is not early accuſtomed to be chained, he diſturbs every perſon in the neighbourhood by howling. It is alſo of importance that the perſon who is to train him ſhould give him his food.

When the dog has attained the age of 10 or 12 months, he may be carried into the field to be regularly trained. At firſt he may be allowed to follow his own inclination, and to run after every animal he ſees. His indiſcriminating eagerneſs will ſoon abate, and he will purſue only partridges and hares. He will ſoon become tired of following partridges in vain, and will content himſelf after having fluſhed them to follow them with his eyes. It will be more difficult to prevent him from following hares.

All young dogs are apt to *rake*; that is, to hunt with their noſes cloſe to the ground, to follow birds rather by the track than by the wind. But partridges lie much better to dogs that *wind* them, than to thoſe that follow them by the track. The dog that winds the ſcent approaches the birds by degrees and without diſturbing them; but they are immediately alarmed when they ſee a dog tracing their footſteps. When you perceive that your dog is committing this fault, call to him in an angry tone *hold up:* he will then grow uneaſy and agitated, going firſt to the one ſide and then to the other, until the wind brings him the ſcent of the birds. After finding the *game* four or five times in this way, he will take the wind of himſelf, and hunt with his noſe high. If it be difficult to correct this fault, it will be neceſſary to put the *puzzle peg* upon him. This is of very ſimple conſtruction, conſiſting only

Shooting. only of a piece of oak or deal inch board, one foot in length, and an inch and a half in breadth, tapering a little to one end; at the broader end are two holes running longitudinally, through which the collar of the dog is put, and the whole is buckled round his neck; the piece of wood being projected beyond his nose, is then fastened with a piece of leather thong to his under jaw. By this means the peg advancing seven or eight inches beyond his snout, the dog is prevented from putting his nose to the ground and raking.

As soon as the young dog knows his game you must bring him under complete subjection. If he is tractable, this will be easy; but if he is stubborn, it will be necessary to use the *trash cord*, which is a rope or cord of 20 or 25 fathoms in length fastened to his collar. If he refuse to come back when called upon, you must check him smartly with the cord, which will often bring him upon his haunches. But be sure you never call to him except when you are within reach of the cord. After repeating this several times he will not fail to come back when called; he ought then to be caressed, and a bit of bread should be given him. He ought now constantly to be tied up, and never unchained, except when you give him his food, and even then only when he has done something to deserve it.

The next step will be to throw down a piece of bread on the ground, at the same moment taking hold of the dog by the collar, calling out to him, "take heed,—softly." After having held him in this manner for some space of time, say to him, "seize—lay hold." If he is impatient to lay hold of the piece of bread before the signal is given, correct him gently with a small whip. Repeat this lesson until he "takes heed" well, and no longer requires to be held fast to prevent him from laying hold of the bread. When he is well accustomed to this manége, turn the bread with a stick, holding it in the manner you do a fowling-piece, and having done so, cry *seize*. Never suffer the dog to eat either in the house or field without having first made him take heed in this manner.

Then, in order to apply this lesson to the game, fry small pieces of bread in hogs lard, with the dung of partridge; take these in a linen bag into the fields, stubbles, ploughed grounds, and pastures, and there put the pieces in several different places, marking the spots with little cleft pickets of wood, which will be rendered more distinguishable by putting pieces of card in the nicks. This being done, cast off the dog and conduct him to these places, always hunting in the wind. After he has caught the scent of the bread, if he approaches too near, and seems eager to fall upon it, cry to him in a menacing tone, "take heed;" and if he does not stop immediately, correct him with the whip. He will soon comprehend what is required of him, and will stand.

At the next lesson, take your gun charged only with powder, walk gently round the piece of bread once or twice, and fire instead of crying *seize*. The next time of practising this lesson, walk round the bread four or five times, but in a greater circle than before, and continue to do this, until the dog is conquered of his impatience, and will stand without moving until the signal is given him. When he keeps his point well, and stands steady in this lesson, you may carry him to the birds; if he runs in upon them, or barks when they spring up, you must correct him; and if he continues to do so, you must return to the fried bread; but this is seldom necessary. Shooting.

When the dog has learned by this use of the bread to take heed, he may be carried to the fields with the trash-cord dragging on the ground. When he springs birds for the first time, if he runs after them or barks, check him by calling out to him, *take heed*. If he point properly, caress him; but you ought never to hunt without the cord until he point staunch.

19 And preventing his running after sheep.

If the dog runs after sheep, and it be difficult to cure him, couple him with a ram, and then whip the dog as long as you can follow him. His cries will at first alarm the ram; he will run with all his speed, and drag the dog along with him; but he will at length take courage, turn upon the dog, and butt him severely with his horns. When you think the dog is sufficiently chastised, untie him: he will never run at sheep again.

Having now given a few general instructions concerning the best method of training pointers, we shall subjoin a few observations respecting the most common species of game, the partridge, pheasant, grouse, woodcock, snipe, and wild duck.

20 Observations concerning the partridge.

Partridges pair in the spring, and lay their eggs (generally from 15 to 20) during May and part of June. The young begin to fly about the end of June, and their plumage is complete in the beginning of October. The male has a conspicuous horseshoe upon his breast, an obtuse spur on the hinder part of the leg, which distinguishes him from the female. He is also rather larger.

When a sportsman is shooting in a country where the birds are thin, and he no longer chooses to range the field for the bare chance of meeting with them, the following method will show him where to find them on another day. In the evening, from sun-set to nightfall, he should post himself in a field, at the foot of a tree or a bush, and there wait until the partridge begin to call or juck, which they always do at that time; not only for the purpose of drawing together when separated, but also when the birds composing the covey are not dispersed. After calling in this manner for some little space of time, the partridges will take to flight; then, if he mark the place where they alight, he may be assured they will lie there the whole night, unless disturbed. Let him return to the same post the next morning by break of day, and there watch a while; being careful to keep his dog in a string, if he is not under perfect command.

As soon as the dawn begins to peep, the partridges will begin to call, and soon afterwards will perform the same manœuvre as on the preceding evening; that is, after having called a while, they will take their flight, and will most commonly settle at a little distance. There in a few minutes they will call again, and sometimes take a second flight, but that will be to no great distance. Then as soon as the sun is risen, and the sportsman can see to shoot, he may cast off his dog and pursue them.

21 Pheasant.

The *pheasant* is of the size of a common dunghill cock, and lays its eggs generally in the woods, the number of which is 10 or 12.

Pheasants are accounted stupid birds; for when they are surprised they will frequently squat down like a rabbit, supposing themselves to be in safety as soon as their heads

Shooting. heads are concealed; and in this way they will sometimes ſuffer themſelves to be killed with a ſtick. They love low and moiſt places, and haunt the edges of thoſe pools which are found in woods, as well as the high graſs of marſhes that are near at hand; and above all, places where there are clumps of alders.

22 Grouſe. *Grouſe*, or muir-game, are found in Wales, in the northern counties of England, and in great abundance in Scotland. They chiefly inhabit thoſe mountains and muirs which are covered with heath, and ſeldom deſcend to the low grounds. They fly in companies of four or five braces, and love to frequent moſſy places, particularly in the middle of the day or when the weather is warm. In purſuing this game, when the pointer ſets, and the ſportſman perceives the birds running with their heads erect, he muſt run after them as faſt as he can, in the hope that he may get near enough to ſhoot when they riſe upon the wing; for he may be pretty certain they will not lie well that day. As theſe birds are apt to grow ſoon putrid, they ought to be drawn carefully the inſtant they are ſhot and ſtuffed with any heath, and if the feathers happen to be wetted they muſt be wiped dry.

23 Woodcock. The *woodcock* is a bird of paſſage; it commonly arrives about the end of October, and remains until the middle of March. Woodcocks are fatteſt in December and January, but from the end of February they are lean. At their arrival they drop anywhere, but afterwards take up their reſidence in copſes of nine or ten years growth. They ſeldom, however, ſtay in one place longer than 12 or 15 days. During the day they remain in thoſe parts of the woods where there are void ſpaces or glades, picking up earth-worms and grubs from the fallen leaves. In the evening they go to drink and waſh their bills at pools and ſprings, after which they repair to the open fields and meadows for the night. It is remarkable, that when a woodcock ſprings from a wood to go into the open country, he always endeavours to find ſome glade or opening, which he follows to the boundaries of the wood. At his return he purſues the ſame path a good way, and then turns to the right or left oppoſite to ſome glade, in order to drop into a thick part of the wood, where he may be ſheltered from the wind. He may therefore be watched with advantage in theſe narrow paſſes and little alleys on the edges of woods which lead to a pool or ſpring, or he may be watched in the duſk of the evening near the pools which he frequents.

24 Snipe. The *ſnipe* is a bird of paſſage as well as the woodcock. This bird is ſcarcely worth ſhooting till the froſt commences. In the month of November they begin to grow fat. Snipes, like woodcocks, frequent ſprings, bogs, and marſhy places, and generally fly againſt the wind. The ſlant and croſs ſhots are rather difficult, as the birds are ſmall and fly very quickly. The ſportſman ought to look for them in the direction of the wind; becauſe then they will fly towards him, and preſent a fairer mark.

25 Wild duck. The *wild duck* is alſo a bird of paſſage, and arrives here in great flocks from the northern countries in the beginning of winter. Still, however, a great many remain in our marſhes and fens during the whole year, and breed.

The wild duck differs little in plumage from the tame duck, but is eaſily diſtinguiſhed by its ſize, which is leſs; by the neck, which is more ſlender; by the foot, which is ſmaller; by the nails, which are more black; and above all, by the web of the foot, which is much finer and ſofter to the touch. Shooting || Shore.

In the ſummer ſeaſon, when it is known that a team of young ducks are in a particular piece of water, and juſt beginning to fly, the ſportſman is ſure to find them early in the morning dabbling at the edges of the pool, and amongſt the long graſs, and then he may get very near to them: it is uſual alſo to find them in thoſe places at noon.

In the beginning of autumn almoſt every pool is frequented by teams of wild ducks, which remain there during the day, concealed in the ruſhes. If theſe pools are of ſmall extent, two ſhooters, by going one on each ſide, making a noiſe and throwing ſtones into the ruſhes, will make them fly up; and they will in this way frequently get ſhots, eſpecially if the pool is not broad, and contracts at one end. But the ſureſt and moſt ſucceſsful way, is to launch a ſmall boat or trow on the pool, and to traverſe the ruſhes by the openings which are found; at the ſame time making as little noiſe as poſſible. In this manner the ducks will ſuffer the ſportſmen to come ſufficiently near them to ſhoot flying; and it often happens that the ducks, after having flown up, only make a circuit, return in a little time, and again alight upon the pool. Then the ſportſmen endeavour a ſecond time to come near them. If ſeveral ſhooters are in company, they ſhould divide, two ſhould go in the boat, whilſt the others ſpread themſelves about the edge of the pool, in order to ſhoot the ducks in their flight. In pools which will not admit a trow, water-ſpaniels are abſolutely neceſſary for this ſport.

In winter they may be found on the margins of little pools; and when pools and rivers are frozen up, they muſt be watched for in places where there are ſprings and waters which do not freeze. The ſport is then much more certain, becauſe the ducks are confined to theſe places in order to procure aquatic herbs, which are almoſt their only food at this period.

SHOP-LIFTERS, are thoſe that ſteal goods privately out of ſhops; which, being to the value of 5s. though no perſon be in the ſhop, is felony without the benefit of clergy by the 10 and 11 W. III. c. 23.

SHORE, a place waſhed by the ſea, or by ſome large river.

Count Marſigli divides the ſea-ſhore into three portions: the firſt of which is that track of land which the ſea juſt reaches in ſtorms and high tides, but which it never covers; the ſecond part of the ſhore is that which is covered in high tides and ſtorms, but is dry at other times; and the third is the deſcent from this, which is always covered with water.

The firſt part is only a continuation of the continent, and ſuffers no alteration from the neighbourhood of the ſea, except that it is rendered fit for the growth of ſome plants, and wholly unfit for that of others, by the ſaline ſteams and impregnations: and it is ſcarce to be conceived by any, but thoſe who have obſerved it, how far on land the effects of the ſea reach, ſo as to make the earth proper for plants which will not grow without this influence; there being ſeveral plants frequently found on high hills and dry places, at three, four, and more miles from the ſea, which yet would not grow unleſs in the neighbourhood of it, nor will ever be found elſewhere.

Shore || Short.

The ſecond part or portion of the ſhore is much more affected by the ſea than the former, being frequently waſhed and beaten by it. Its productions are rendered ſalt by the water, and it is covered with ſand, or with the fragments of ſhells in form of ſand, and in ſome places with a tartarous matter depoſited from the water; the colour of this whole extent of ground is uſually duſky and dull, eſpecially where there are rocks and ſtones, and theſe covered with a ſlimy matter.

The third part of the ſhore is more affected by the ſea than either of the others; and is covered with an uniform cruſt of the true nature of the bottom of the ſea, except that plants and animals have their reſidence in it, and the decayed parts of theſe alter it a little.

SHORE (Jane), the celebrated concubine of the licentious king Edward IV. was the wife of Mr Matthew Shore, a goldſmith in Lombard ſtreet, London. Kings are ſeldom unſucceſsful in their amorous purſuits; therefore there was nothing wonderful in Mrs Shore's removing from Lombard-ſtreet to ſhine at court as the royal favourite. Hiſtorians repreſent her as extremely beautiful, remarkably cheerful, and of moſt uncommon generoſity. The king, it is ſaid, was no leſs captivated with her temper than with her perſon: ſhe never made uſe of her influence over him to the prejudice of any perſon; and if ever ſhe importuned him, it was in favour of the unfortunate. After the death of Edward, ſhe attached herſelf to the lord Haſtings; and when Richard III. cut off that nobleman as an obſtacle to his ambitious ſchemes, Jane Shore was arreſted as an accomplice, on the ridiculous accuſation of witchcraft. This, however, terminated only in a public penance; excepting that Richard rifled her of all her little property: but whatever ſeverity might have been exerciſed towards her, it appears that ſhe was alive, though ſufficiently wretched, under the reign of Henry VIII. when Sir Thomas More ſaw her poor, old, and ſhrivelled, without the leaſt trace of her former beauty. Mr Rowe, in his tragedy of Jane Shore, has adopted the popular ſtory related in the old hiſtorical ballad, of her periſhing by hunger in a ditch where Shoreditch now ſtands. But Stow aſſures us that ſtreet was ſo named before her time.

SHORL. See SCHORL.

SHORLING and MORLING, are words to diſtinguiſh fells of ſheep; *ſhorling* being the fells after the fleeces are ſhorn off the ſheep's back; and *morling*, the fells flead off after they die or are killed. In ſome parts of England they underſtand by a *ſhorling*, a ſheep whoſe face is ſhorn off; and by a *morling*, a ſheep that dies.

SHORT (James), an eminent optician, was born in Edinburgh on the 10th of June, O. S. in the year 1710. At ten years of age, having loſt his father and mother, and being left in a ſtate of indigence, he was received into Heriot's Hoſpital, (ſee *EDINBURGH Public Buildings*, n° 16.), where he ſoon diſplayed his mechanical genius in conſtructing, for himſelf, little cheſts, book-caſes, and other conveniences, with ſuch tools as fell in his way. At the age of twelve he was removed from the Hoſpital to the High School, where he ſhowed a conſiderable taſte for claſſical literature, and generally kept at the head of his forms. In the year 1726 he was entered into the univerſity, where he paſſed through the uſual courſe of education, and took his maſter's degree with great applauſe. Short.

By his friends he was intended for the church; but after attending a courſe of theological lectures, his mind revolted from a profeſſion which he thought little ſuited to his talents; and he devoted his whole time to mathematical and mechanical purſuits. He had been fortunate enough to have the celebrated M'Laurin for his preceptor; who having ſoon diſcovered the bent of his genius, and made a proper eſtimate of the extent of his capacity, encouraged him to proſecute thoſe ſtudies in which nature had qualified him to make the greateſt figure. Under the eye of that eminent maſter, he began in 1732 to conſtruct Gregorian teleſcopes; and, as the profeſſor obſerved in a letter to Dr Jurin, "by taking care of the figure of his ſpecula, he was enabled to give them larger apertures, and to carry them to greater perfection, than had ever been done before him." See OPTICS, n° 97.)

In the year 1736 Mr Short was called to London, at the deſire of Queen Caroline, to give inſtructions in mathematics to William duke of Cumberland; and immediately on his appointment to that very honourable office he was elected a fellow of the royal ſociety, and patroniſed by the earls of Morton and Macclesfield. In the year 1739 he accompanied the former of thoſe noble lords to the Orkney Iſles, where he was employed in adjuſting the geography of that part of Scotland: and happy it was for him that he was ſo employed, as he might otherwiſe have been involved in a ſcuffle which took place between the retainers of Sir James Stewart of Barra and the attendants of the earl, in which ſome of the latter were dangerouſly wounded.

Mr Short having returned to London, and finally eſtabliſhed himſelf there in the line of his profeſſion, was in 1743 employed by lord Thomas Spencer to make for him a reflector of twelve feet focus, for which he received 600 guineas. He made ſeveral other teleſcopes of the ſame focal diſtance with greater improvements and higher magnifiers; and in 1752 finiſhed one for the king of Spain, for which, with its whole apparatus, he received 1200l. This was the nobleſt inſtrument of the kind that had then been conſtructed, and perhaps it has never yet been ſurpaſſed except by the aſtoniſhing reflectors of Herſchel. See TELESCOPE.

Mr Short was wont to viſit the place of his nativity once every two or three years during his reſidence in London, and in 1766 he viſited it for the laſt time. On the 15th of June 1768 he died, after a very ſhort illneſs, at Newington Butts, near London, of a mortification in his bowels, and was buried on the 22d of the ſame month, having completed, within a few days, his fifty-eighth year. He left a fortune of about 20,000l. of which 15,000 l. was bequeathed to two nephews, and the reſt in legacies to his friends. In gratitude for the ſteady patronage of the earl of Morton, he left to his daughter the Lady Mary Douglas, afterwards counteſs of Aboyne, 1000l. and the reverſion of his fortune, ſhould his nephews die without iſſue; but this reverſionary legacy the lady, at the deſire of her father, generouſly relinquiſhed by a deed in favour of Mr Short's brother Mr Thomas Short and his children. Mr Short's eminence as an artiſt is univerſally known, and we have often heard him ſpoken of by thoſe who had known

Short || Shot.

known him from his youth, as a man of virtue and of very amiable manners.

Short-Hand Writing. See Stenography.

Short-jointed, in the manege. A horſe is ſaid to be ſhort-jointed that has a ſhort paſtern; when this joint, or the paſtern is too ſhort, the horſe is ſubject to have his fore legs from the knee to the cornet all in a ſtraight line. Commonly your ſhort-jointed horſes do not manege ſo well as the long-jointed; but out of the manege the ſhort-jointed are the beſt for travel or fatigue.

Short-Sightedneſs, a certain defect in viſion, by which objects cannot be diſtinctly ſeen unleſs they are very near the eye. See Optics, n° 155.

SHORTFORD, q. d. *fore-cloſe*, an ancient cuſtom in the city of Exeter, when the lord of the fee cannot be anſwered rent due to him out of his tenement, and no diſtreſs can be levied for the ſame. The lord is then to come to the tenement, and there take a ſtone, or ſome other dead thing off the tenement, and bring it before the mayor and bailiff, and thus he muſt do ſeven quarter days ſucceſſively; and if on the ſeventh quarter-day the lord is not ſatisfied of his rent and arrears, then the tenement ſhall be adjudged to the lord to hold the ſame a year and a day; and forthwith proclamation is to be made in the court, that if any man claims any title to the ſaid tenement, he muſt appear within the year and day next following, and ſatisfy the lord of the ſaid rent and arrears: but if no appearance be made, and the rent not paid, the lord comes again to the court, and prays that, according to the cuſtom, the ſaid tenement be adjudged to him in his demeſne as of fee, which is done accordingly, ſo that the lord hath from thenceforth the ſaid tenement, with the appurtenances to him and his heirs.

SHOT, a denomination given to all ſorts of balls for fire-arms; thoſe for cannon being of iron, and thoſe for guns, piſtols, &c. of lead. See Shooting.

Caſe Shot formerly conſiſted of all kinds of old iron, nails, muſket-balls, ſtones, &c. uſed as above.

Shot of a Cable, on ſhip-board, is the ſplicing of two cables together, that a ſhip may ride ſafe in deep waters and in great roads; for a ſhip will ride eaſier by one ſhot of a cable, than by three ſhort cables out ahead.

Grape Shot. See *Grape-Shot*.

Patent milled Shot is thus made: Sheets of lead, whoſe thickneſs correſponds with the ſize of the ſhot required, are cut into ſmall pieces, or cubes, of the form of a die. A great quantity of theſe little cubes are put into a large hollow iron cylinder, which is mounted horizontally and turned by a winch; when by their friction againſt one another and againſt the ſides of the cylinder, they are rendered perfectly round and very ſmooth. The other patent ſhot is caſt in moulds, in the ſame way as bullets are.

Shot-Flaggon, a ſort of flaggon ſomewhat bigger than ordinary, which in ſome counties, particularly Derbyſhire, it is the cuſtom for the hoſt to ſerve his gueſts in, after they have drank above a ſhilling.

Small Shot, or that uſed for fowling, ſhould be well ſized, and of a moderate bigneſs: for ſhould it be too great, then it flies thin, and ſcatters too much; or if too ſmall, then it hath not weight and ſtrength to penetrate far, and the bird is apt to fly away with it. In order, therefore, to have it ſuitable to the occaſion, it not being always to be had in every place fit for the purpoſe, we ſhall ſet down the true method of making all ſorts and ſizes under the name of *mould-ſhot*. Its principal good properties are to be round and ſolid. Shot.

Take any quantity of lead you think fit, and melt it down in an iron veſſel; and as it melts keep it ſtirring with an iron ladle, ſkimming off all impurities whatſoever that may ariſe at the top: when it begins to look of a greeniſh colour, ſtrew on it as much auripigmentum or yellow orpiment, finely powdered, as will lie on a ſhilling, to every 12 or 14 pound of lead; then ſtirring them together, the orpiment will flame.

The ladle ſhould have a notch on one ſide of the brim, for more eaſily pouring out the lead; the ladle muſt remain in the melted lead, that its heat may be the ſame with that of the lead, to prevent inconveniences which otherwiſe might happen by its being either too hot or too cold: then, to try your lead, drop a little of it into water, and if the drops prove round, then the lead is of a proper heat; if otherwiſe, and the ſhot have tails, then add more orpiment to increaſe the heat, till it be found ſufficient.

Then take a plate of copper, about the bigneſs of a trencher, which muſt be made with a hollowneſs in the middle, about three inches compaſs, within which muſt be bored about 40 holes according to the ſize of the ſhot which you intend to caſt: the hollow bottom ſhould be thin; but the thicker the brim, the better it will retain the heat. Place this plate on a frame of iron, over a tub or veſſel of water, about four inches from the water, and ſpread burning coals on the plate, to keep the lead melted upon it: then take ſome lead and pour it gently on the coals on the plate, and it will make its way through the holes into the water, and form itſelf into ſhot; do thus till all your lead be run through the holes of the plate, taking care, by keeping your coals alive, that the lead do not cool, and ſo ſtop up the holes.

While you are caſting in this manner, another perſon with another ladle may catch ſome of the ſhot, placing the ladle four or five inches underneath the plate in the water, by which means you will ſee if they are defective, and rectify them.

Your chief care is to keep the lead in a juſt degree of heat, that it be not ſo cold as to ſtop up the holes in your plate, nor ſo hot as to cauſe the ſhot to crack: to remedy the heat, you muſt refrain working till it is of a proper coolneſs; and to remedy the coolneſs of your lead and plate, you muſt blow your fire; obſerving, that the cooler your lead is, the larger will be your ſhot; as the hotter it is, the ſmaller they will be.

After you have done caſting, take them out of the water, and dry them over the fire with a gentle heat, ſtirring them continually that they do not melt; when dry, you are to ſeparate the great ſhot from the ſmall, by the help of a ſieve made for that purpoſe, according to their ſeveral ſizes. But thoſe who would have very large ſhot, make the lead trickle with a ſtick out of the ladle into the water, without the plate.

If it ſtop on the plate, and yet the plate be not too cool, give but the plate a little knock, and it will run again; care muſt be had that none of your implements be greaſy, oily, or the like; and when the ſhot, being ſeparated, are found too large or too ſmall for your purpoſe,

Shot.

poſe, or otherwiſe imperfect, they will ſerve again at the next operation.

The ſizes of common ſhot for fowling are from N° 1 to 6, and ſmaller, which is called muſtard ſeed, or duſt ſhot; but N° 5 is ſmall enough for any ſhooting whatſoever. The N° 1 may be uſed for wild geeſe; the N° 2 for ducks, widgeons, and other water-fowl; the N° 3 for pheaſants, partridges after the firſt month, and all the fen-fowl; the N° 4 for partridges, woodcocks, &c.; and the N° 5 for ſnipes and all the ſmaller birds.

Tin-Caſe SHOT, in artillery, is formed by putting a great quantity of ſmall iron ſhot into a cylindrical tin-box called a canniſter, that juſt fits the bore of the gun. Leaden bullets are ſometimes uſed in the ſame manner; and it muſt be obſerved, that whatever number or ſizes of the ſhots are uſed, they muſt weigh with their caſes nearly as much as the ſhot of the piece.

SHOVEL (Sir Claudeſly), was born about the year 1650 of parents rather in the lower rank of life. He was put apprentice to a ſhoemaker; but diſliking this profeſſion, he abandoned it a few years after, and went to ſea. He was at firſt a cabin boy with Sir Chriſtopher Mynns, but applying to the ſtudy of navigation with indefatigable induſtry, his ſkill as a ſeaman ſoon raiſed him above that ſtation.

The corſairs of Tripoli having committed great outrages on the Engliſh in the Mediterranean, Sir John Narborough was ſent in 1674 to reduce them to reaſon. As he had received orders to try the effects of negociation before he proceeded to hoſtilities, he ſent Mr Shovel, who was at that time a lieutenant in his fleet, to demand ſatisfaction. The Dey treated him with a great deal of diſreſpect, and ſent him back without an anſwer. Sir John diſpatched him a ſecond time, with orders to remark particularly the ſituation of things on ſhore. The behaviour of the Dey was worſe than ever. Upon Mr Shovel's return, he informed Sir John that it would be poſſible, notwithſtanding their fortifications, to burn all the ſhips in the harbour. The boats were accordingly manned, and the command of them given to Lieut. Shovel, who ſeized the guardſhip, and burnt four others, without loſing a man. This action ſo terrified the Tripolins, that they ſued for peace.—Sir John Narborough gave ſo favourable an account of this exploit, that Mr Shovel was ſoon after made captain of the Sapphire, a fifth rate ſhip.

In the battle of Bantry-Bay, after the revolution, he commanded the Edgar, and, for his gallant behaviour in that action, was ſoon after knighted by king William. Next year he was employed in tranſporting an army into Ireland; a ſervice which he performed with ſo much diligence and dexterity, that the king raiſed him to the rank of rear-admiral of the blue, and delivered his commiſſion with his own hands. Soon after he was made rear admiral of the red, and ſhared the glory of the victory at La Hogue. In 1694, he bombarded Dunkirk. In 1703, he commanded the grand fleet in the Mediterranean, and did every thing in his power to aſſiſt the Proteſtants who were in arms in the Cevennes.

Soon after the battle off Malaga, he was preſented by prince George to Queen Anne, who received him graciouſly, and next year employed him as commander in chief.

In 1705 he commanded the fleet, together with the earls of Peterborough and Monmouth, which was ſent into the Mediterranean; and it was owing to him chiefly that Barcelona was taken. After an unſucceſsful attempt upon Toulon, he ſailed for Gibraltar, and from thence homeward with a part of the fleet. On the 22d of October, at night, his ſhip, with three others, was caſt away on the rocks of Scilly. All on board periſhed. His body was found by ſome fiſhermen on the iſland of Scilly, who ſtripped it of a valuable ring, and afterwards buried it. Mr Paxton, the purſer of the Arundel, hearing of this, found out the fellows, and obliged them to diſcover where they had buried the body. He carried it on board his own ſhip to Portſmouth, from whence it was conveyed to London, and interred with great ſolemnity in Weſtminſter Abbey. A monument was afterwards erected to his memory by the direction of the Queen. He married the widow of his patron, Sir John Narborough, by whom he left two daughters, co-heireſſes.

Shoveler || Shrewſbury.

SHOVELER, in ornithology, a ſpecies of ANAS.

SHOULDER-BLADE, a bone of the ſhoulder, of a triangular figure, covering the hind part of the ribs, called by anatomiſts the *ſcapula* and *omoplata*. See ANATOMY.

SHOUT, CLAMOUR, in antiquity, was frequently uſed on eccleſiaſtical, civil, and military occaſions, as a ſign of approbation, and ſometimes of indignation.—Thus as Cicero, in an aſſembly of the people, was expoſing the arrogance of L. Antony, who had had the impudence to cauſe himſelf to be inſcribed the patron of the Romans, the people on hearing this raiſed a ſhout to ſhow their indignation. In the ancient military diſcipline, ſhouts were uſed, 1. Upon occaſion of the general's making a ſpeech or harangue to the army from his tribunal. This they did in token of their approving what had been propoſed. 2. Before an engagement, in order to encourage and ſpirit their own men, and fill the enemy with dread. This is a practice of great antiquity; beſides which, it wants not the authority of reaſon to ſupport it; for as mankind are endowed with two ſenſes, hearing and ſeeing, by which fear is raiſed in the mind, it may be proper to make uſe of the ear as well as the eye for that purpoſe. Shouts were alſo raiſed in the ancient theatre, when what was acted pleaſed the ſpectators. It was uſual for thoſe preſent at the burning of the dead to raiſe a great ſhout, and call the dead perſon by his name before they ſet fire to the pile.

SHOWER, in meteorology, a cloud condenſed into RAIN.

SHREWMOUSE. See SOREX.

SHREWSBURY, the capital of Shropſhire in England. This town, the metropolis of the county, grew up out of the ruins of Uriconium, anciently a city, now a village called *Wroxeter*, about four miles from it. The Saxons called it *Scrobbes Berig*, from the ſhrubs that grew about it; and from thence the preſent name of *Shrewſbury* is ſuppoſed to have been formed. It is pleaſantly ſituated upon a hill near the Severn, over which there are two handſome bridges. It was a place of note in the Saxon times; after which it was granted by William the Conqueror, together with the title of *earl* and moſt of the county, to Roger de Montgomery, who built a caſtle upon the north ſide of it, where the Severn, that encompaſſes it on all other ſides, leaves an opening. His ſon Robert built alſo a wall acroſs this neck of land, when he revolted

Shrewsbury.

from Henry I. We learn from doomsday-book, that at that time, when a widow of this town married, she paid 20 shillings to the king, and a virgin 10. The above-mentioned Roger founded also, and endowed here, a Benedictine monastery and a collegiate church. When old age came upon him, he quitted the world, and spent the rest of his days as a monk in the abbey, and when he died was interred in its church. From the history of this church and monastery, it appears, that ecclesiastical benefices about that time were hereditary. The abbey became so rich afterwards, that the abbot was mitred, and sat in parliament. Besides this abbey, in after times there were three others, viz. a Franciscan, Dominican, and Augustin, and likewise two collegiate churches; one dedicated to St Chad and the other to St Mary. In the contest between the empress Maud and Stephen, this town, and its governor William Fitz-Allan, sided with the empress. In Henry III.'s time, a part of it was burnt down by the Welch; and in Richard II.'s reign a parliament was held in it. At a place called *Battlefield*, near this town, Henry Percy the younger, surnamed *Hotspur*, was killed in an engagement with Henry IV. against whom he had rebelled. The king afterwards built a chapel upon the spot, and endowed it for the support of two priests to pray for the souls of the slain. Two of Edw. IV.'s sons were born here; namely, Richard, duke of York, whom Perkin Warbeck afterwards personated, and who was murdered in the Tower; and George Plantagenet, who died before his brothers. Here first broke out the sweating-sickness, which carried off great numbers so suddenly, that those who were seized with it either died or recovered in the space of 24 hours. In the beginning of the civil wars, king Charles I. came hither, and formed an army, with which he marched towards London; but was met by the parliament's forces at Edgehill. He continued here from the 20th of September to the 12th of October, during which time he was joined by prince Rupert, and many of the gentry and nobility of these parts. This town anciently gave title of earl to the Montgomeries, and afterwards to the Talbots, by whom it is still retained. Here is a free grammar-school, with three masters, and several ushers, well endowed by Edward VI. and queen Elizabeth, and not inferior to many colleges in the universities. It has a good library and chapel, and there are several scholarships appropriated to it in the university of Cambridge. Here are also several hospitals, alms-houses, and charity-schools. This town is one of the most flourishing in England, having two great weekly markets for corn, cattle, and provisions; and another for Welch cottons and flannels, of which great quantities are sold. A great trade is carried on with the Welch, who bring their commodities hither, as to the common mart of both nations. The town is large and well-built, and the situation extremely pleasant. There is a very beautiful walk called the *quarry*, between the town walls and the Severn, delightfully shaded with rows of lime-trees, so that it is not inferior to the Mall in St James's Park. The town is also noted for its gallantry and politeness, being full of gentry, for whom there are always balls and assemblies once a-week all the year round.—Here is a fine house and gardens, which belonged to the earl of Bradford; and in the neighbourhood, at Wroxeter, the Roman highway, called Watling-street, may be seen for several miles, where Roman coins are frequently found. In Shrewsbury are 12 incorporated trading companies; and the corporation has a power to try even capital causes of itself, except high treason. It is said that thigh-bones of dead men have been found here a yard long, and teeth three inches round and three long.

Shrike || Shropshire.

SHRIKE. See LANIUS.

SHRIMP, in ichthyology. See CANCER, n° 5. and 6.

SHRINE, in ecclesiastical history, a case or box to hold the relics of some saint.

SHROPSHIRE, a county of England, bounded on the south by Worcestershire, Herefordshire, and Radnorshire; on the north, by Cheshire; on the east, by Staffordshire; on the west, by Montgomeryshire and Denbighshire, in Wales. Its length is between 49 and 50 miles, its breadth about 38, and its circumference about 210. It is an inland county, containing 890,000 acres, 113,680 inhabitants, and 15 hundreds, in which are 170 parishes, and 15 market towns. It makes a part of three bishoprics, viz. Hereford, Coventry and Litchfield, and St Asaph. Some part of it lies on the north, and some on the south side of the Severn. Besides the Severn, it is also watered by the *Temd* or *Tefidiauc*, as it is called in Welch, which flows from the mountains of Radnorshire; and by the Tern, which has its rise and name from one of those pools called *tearnes*, in Staffordshire. All these abound with fish, especially trouts, pikes, lampreys, graylings, carp, and eels. The air, especially upon the hills, with which the county abounds, is very wholesome. There is as great a diversity of soil as in most other counties. On the hills, where it is poor, is very good pasture for sheep; and in the low grounds, where it is very rich, along the Severn in particular, there is plenty of grass for hay and black cattle, with all sorts of corn. No county is better provided with fuel than this, having in it many inexhaustible pits of coal, and also mines of lead and iron. Over most of the coal-pits in this county lies a stratum or layer of blackish porous rock, of which, by grinding and boiling, they make pitch and tar, which are rather better than the common sort for caulking ships, as they do not crack, but always continue close and smooth. Quarries of lime-stone and iron-stone are common enough in the county, and the soil in many places is a reddish clay. As it lies upon the borders of Wales, it was anciently full of castles and walled towns. On the side next that country there was an almost continued line of castles, to guard the county against the inroads and depredations of the Welch. The borders here, as those between England and Scotland, were called *marches*, and there were certain noblemen intitled *barones marchiæ*, *marchiones de marchia Walliæ*, "lords of the marches, or marquisses of the marches of Wales," who were vested with a sort of palatine jurisdiction, held courts of justice to determine controversies, and enjoyed many privileges and immunities, the better to enable and encourage them to protect the county against the incursions of the Welch, and to maintain order amongst the borderers; but they often abused their power, and were the greatest of tyrants.

As to the ecclesiastical government of the county, the far greater part, namely, all that belongs to the bishoprics of Hereford, and of Litchfield and Coventry,

Shrove || Shrub.

is under the jurisdiction and visitation of the archdeacon of Shrewsbury or Salop, and is divided into several deanries.

The Oxford circuit includes in it this county, which sends 12 members to parliament, viz. two for the shire, and two for each of the following towns, Shrewsbury, Ludlow, Wenlock, and Bishop's Castle.

SHROVE-TUESDAY, is the Tuesday after Quinquagesima Sunday, or the day immediately preceding the first of Lent; being so called from the Saxon word *shrive*, which signifies "to confess." Hence Shrove-Tuesday signifies Confession-Tuesday; on which day all the people in every parish throughout England (during the Romish times) were obliged to confess their sins, one by one, to their own parish-priests, in their own parish-churches; and, that this might be done the more regularly, the great bell in every parish was rung at ten o'clock (or perhaps sooner), that it might be heard by all, and that they might attend, according to the custom then in use. And though the Romish religion has now given way to the Protestant religion, the custom of ringing the great bell in our ancient parish-churches, at least in some of them, still remains, and obtains in and about London the name of Pancake bell; perhaps, because after the confession it was customary for the several persons to dine on pancakes or fritters. Most churches, indeed, have rejected that custom of ringing the bell on Shrove-Tuesday; but the usage of dining on pancakes or fritters, and such like provision, still continues.

SHROUDS (*scrud* Sax.), a range of large ropes extending from the mast-heads to the right and left side of the ship, to support the masts, and enable them to carry sail, &c.

The shrouds as well as the sails are denominated from the masts to which they belong. Thus they are the main, fore, and mizen shrouds; the main-top-mast, fore-top-mast, or mizen-top-mast shrouds; and the main-top-gallant, fore-top-gallant, or mizen-top-gallant shrouds. The number of shrouds by which a mast is sustained, as well as the size of rope of which they are formed, is always in proportion to the size of the mast and the weight of the sail it is intended to carry.

Bowsprit shrouds are those which support the bowsprit. Bumkin shrouds are those which support the bumkins. Futtock shrouds are shrouds which connect the efforts of the topmast shrouds to the lower shrouds. Bentinck-shrouds are additional shrouds to support the masts in heavy gales. Preventer shrouds are similar to bentinck-shrouds, and are used in bad weather to ease the lower rigging. See MAST and SAIL.

SHRUB, *frutex*, a little, low, dwarf tree, or a woody vegetable, of a size less than a tree; and which, instead of one single stem, frequently from the same root puts forth several sets or stems. See PLANT and TREE. Such are privet, phillyrea, holly, box, honeysuckle, &c. Shrubs and trees put forth in autumn a kind of buttons, or gems, in the axis of the leaves; these buttons are as so many little ova, which, coming to expand by the warmth of the following spring, open into leaves and flowers. By this, together with the height, some distinguish shrubs from *suffrutices*, or under shrubs, which are low bushes, that do not put forth any of these buttons, as sage, thyme, &c.

Shrub || Shuttle.

The two hardiest shrubs we are possessed of are the ivy and box; these stand the severity of our sharpest winters unhurt, while other shrubs perish, and trees have their solid bodies split and torn to pieces. In the hard winter of the year 1683, these two shrubs suffered no injury any where; though the yews and hollies, which are generally supposed very hardy, were that winter in some places killed, and in others stripped of their leaves, and damaged in their bark. Furze-bushes were found to be somewhat hardier than these, but they sometimes perished, at least down to the root. The broom seemed to occupy the next step of hardiness beyond these. This lived where the others died, and where even this died, the juniper shrubs were sometimes found unhurt. This last is the only shrub that approaches to the hardiness of the box and ivy, but even it does not quite come up to them; for while they suffer nothing in whatever manner they are exposed, the juniper, though it bears cold well under the shelter of other trees, yet cannot bear the vicissitudes of heat and cold; insomuch that some juniper shrubs were found half dead and half vigorous; that side which faced the mid-day sun having perished by the successive thawings and freezings of its sap; while that which was not exposed to the vicissitudes of heat had born the cold perfectly well. Such shrubs as are not hardy enough to defy the winter, but appear half dead in the spring, may often be recovered by Mr Evelyn's method of beating their branches with a slender hazel-wand, to strike off the withered leaves and buds, and give a free passage to the air to the internal parts. Where this fails, the method is to cut them down to the quick, and if no part of the trunk appears in a growing condition, they must be taken off down to the level of the ground. Philosophical Transactions, n° 165.

SHUCKFORD (Samuel), curate of Shelthon in Norfolk, prebendary of Canterbury, and chaplain in ordinary to the king, was a learned Englishman. His manners were those of a philosopher, uncorrupted by the manners of the world. He wrote a history of the world, sacred and profane, to serve as an introduction to Prideaux, in 3 vols 8vo. It is heavily written, but displays a great deal of erudition. His death, which happened in 1756, prevented him from carrying it down to the year 747 before Christ, where Prideaux begins. He wrote also a treatise on the Creation and Fall of Man, to serve as a supplement to the preface to his history.

SHUTTLE, in the manufactures, an instrument used by the weavers, which guides the thread it contains, either of woollen, silk, flax, or other matter, so as to make it form the woofs of stuffs, cloths, linens, ribbands, &c. by throwing the shuttle alternately from left to right, and from right to left, across between the threads of the warp, which are stretched out lengthwise on the loom.

In the middle of the shuttle is a kind of cavity, called the *eye* or *chamber* of the shuttle; wherein is inclosed the spoul, which is a part of the thread destined for the woof; and this is wound on a little tube of paper, rush, or other matter.

The ribband-weaver's shuttle is very different from that of most other weavers, though it serves for the same purpose: it is of box, six or seven inches long, one broad, and as much deep; shod with iron at both

Sialogogues, Siam.

ends, which terminate in points, and are a little crooked, the one towards the right, and the other towards the left, repreſenting the figure of an ∽ horizontally placed. See WEAVING.

SIALOGOGUES, medicines which promote the ſalivary diſcharge.

1 Boundaries and extent.

SIAM PROPER, by ſome called *Upper*, (to diſtinguiſh it from the *Lower* Siam, under which are often included Laos, Cambodia, and Malacca), is bounded on the north by the kingdoms of Pegu and Laos; on the eaſt by Cambodia and Cochin-China; on the ſouth by Malacca and the bay of Siam; and on the weſt by the ocean. But as the opinions of geographers are extremely various concerning the ſituation and extent of moſt of the inland countries of Aſia and Africa, neither the extent nor boundaries of Siam are yet accurately known. By ſome it is ſuppoſed to extend 550 miles in length, and 250 miles in breadth; in ſome places it is not above 50 miles broad.

2 Weather.

The winds blow here from the ſouth upon the coaſt of Siam, in March, April, and May; in April the rains begin, in May and June they fall almoſt without ceaſing. In July, Auguſt, and September, the winds blow from the weſt, and the rains continuing, the rivers overflow their banks nine or ten miles on each ſide, and for more than 150 miles up the ſtream. At this time, and more particularly in July, the tides are ſo ſtrong as to come up the river Menan as far as the city of Siam, which is ſituated 60 miles from its mouth; and ſometimes as far as Louvo, which is 50 miles higher. The winds blow from the weſt and north in October, when the rain ceaſes. In November and December the winds blow dry from the north, and the waters being in a few days reduced to their ancient channels, the tides become ſo inſenſible, that the water is freſh at the mouth of the river. At Siam there is never more than one flood and one ebb in the ſpace of 24 hours. In January the wind blows from the eaſt, and in February from the eaſt and ſouth. When the wind is at eaſt, the current ſets to the weſt; and, on the contrary, when the wind is at weſt, the currents run to the eaſtward.

As this country is ſituated near the tropic, it muſt neceſſarily be very hot; but yet, as in other places nearly of the ſame latitude, when the ſun is vertical and ſhines with a moſt intenſe heat, the inhabitants are ſo ſcreened by the clouds, and the air is ſo refreſhed by a deluge of rain that overflows the plains which the people chiefly inhabit, that the heat is very ſupportable. The cooleſt wind blows in December and January.

3 Vegetable productions.

The vegetable produce of this country is chiefly rice and wheat, beſides tropical and a few European fruits. The Siameſe prepare the land for tillage as ſoon as the earth is ſufficiently moiſtened by the floods. They plant their rice before the waters riſe to any conſiderable height, and, as they riſe ſlowly, the rice keeps pace with them, and the ear is always above the water. They reap their corn when the water retires, and ſometimes go in boats to cut it while the waters are upon the ground. They alſo ſow rice in ſeveral parts of the kingdom that are not overflowed, and this is thought better taſted, and will keep longer, than the other; but they are forced to ſupply theſe fields conſtantly with water, while the rice is growing, from baſins and ponds that lie about them.

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They have no European fruits except oranges, lemons, citrons, and pomegranates. They have bananas, Indian figs, jaques, durions, mangoes, mangoſtans, tamarinds, ananas, and cocoa-nuts; they have alſo abundance of pepper and ſugar-canes. The mountains are covered with trees which make good maſts. The vegetable of greateſt uſe in the country is the bamboo, which grows chiefly in marſhy ſoils, and is often found of a prodigious ſize. Cotton trees are found in great numbers; and others that yield *capoc*, a very fine cotton wool, but ſo ſhort as to be unfit for ſpinning, though it anſwers very well for ſtuffing mattreſſes and pillows.

4 Animals.

There is no country where elephants abound more than in Siam, or where they are held in greater veneration. They have a few horſes, ſheep, and goats, beſides oxen and buffaloes; but they have no good animal food except the fleſh of hogs, their beef and mutton being of a very indifferent quality.

5 Deſcription of the inhabitants.

The Siameſe are of ſmall ſtature, but well proportioned; their complexions are ſwarthy: the faces of both the men and women are broad, and their foreheads, ſuddenly contracting, terminate in a point, as well as their chins. They have ſmall black eyes, hollow jaws, large mouths, and thick pale lips. Their teeth are dyed black, their noſes are ſhort and round at the end, and they have large ears, which they think very beautiful. Their hair is thick and lank, and both ſexes cut it ſo ſhort that it reaches no lower than their ears; the women make it ſtand up on their foreheads; and the men ſhave their beards.

6 Dreſs.

People of diſtinction wear a piece of calico tied about their loins, that reaches down to their knees.—The men bring up this cloth between their legs, and tuck it into their girdles, which gives it the appearance of a pair of breeches. They have alſo a muſlin ſhirt without a collar, with wide ſleeves, no wriſtbands, and the boſom open. In winter they wear a piece of ſtuff or painted linen over their ſhoulders, like a mantle, and wind it about their arms.

The king of Siam is diſtinguiſhed by wearing a veſt of brocaded ſatin, with ſtraight ſleeves that reach down to the wriſt, under ſuch a ſhirt as we have juſt deſcribed, and it is unlawful for any ſubject to wear this dreſs unleſs he receives it from the king. They wear ſlippers with piked toes turned up, but no ſtockings. The king ſometimes preſents a military veſt to the generals; this is buttoned before, and reaches to the knees; but the ſleeves are wide, and come no lower than the elbows. All the retinue of the king, either in war or in hunting, are clothed in red. The king wears a cap in the form of a ſugar-loaf, encompaſſed by a coronet or circle of precious ſtones, and thoſe of his officers have a circle of gold, ſilver, or of vermilion gilt, to diſtinguiſh their quality; and theſe caps are faſtened with a ſtay under the chin; they are only worn when they are in the king's preſence, or when they preſide in courts of juſtice, and on other extraordinary occaſions. They have alſo hats for travelling; but, in general, few people cover their heads notwithſtanding the ſcorching heat of the ſun.

The women alſo wrap a cloth about their middle, which hangs down to the calf of their legs. They cover their breaſts with another cloth, the ends of which hang over their ſhoulders. But they have no garment

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corresponding to a ſhift, nor any covering for their heads but their hair. The common people are almoſt naked, and wear neither ſhoes nor ſlippers. The women wear as many rings on the three laſt fingers of each hand as they can keep on, and bracelets upon their wriſts and ancles, with pendants in their ears ſhaped like a pear.

7 Manners and cuſtoms.

For an inferior to ſtand before a ſuperior is deemed inſolent; and therefore ſlaves and people of inferior rank ſit upon their heels, with their heads a little inclined, and their joined hands liſted up to their foreheads. In paſſing by a ſuperior they bend their bodies, joining their hands, and lifting them toward their heads in proportion to the reſpect they would ſhow. When an inferior pays a viſit, he enters the room ſtooping, proſtrates himſelf, and then remains upon his knees, ſitting upon his heels without ſpeaking a word till he is addreſſed by the perſon whom he viſits; for he that is of the higheſt quality muſt always ſpeak firſt. If a perſon of rank viſits an inferior, he walks upright, and the maſter of the houſe receives him at the door, and waits on him ſo far when he goes away, but never farther.

The higheſt part of the houſe is eſteemed the moſt honourable, and no perſon cares to lodge under another's feet. The Siameſe indeed have but one ſtory, but the rooms riſe gradually, and the innermoſt, which are the higheſt, are always the moſt honourable. When the Siameſe ambaſſador came to the French court, ſome of his retinue were lodged in a floor over the ambaſſador's head; but they no ſooner knew it, than they were ſtruck with the greateſt conſternation, and ran down tearing their hair at the thoughts of being guilty of what they conſidered as ſo unpardonable a crime.

The Siameſe never permit ſuch familiarities as are practiſed by gentlemen in Europe. Eaſineſs of acceſs, and affability to inferiors, is in that part of the world thought a ſign of weakneſs, and yet they take no notice of ſome things which would be looked upon as ill breeding among us; ſuch as belching in company, which no man endeavours to prevent, or ſo much as holds his hand before his mouth. They have an extraordinary reſpect for the head, and it is the greateſt affront to ſtroke or touch that of another perſon; nay, their cap muſt not be uſed with too much familiarity; for when a ſervant carries it, it is put on a ſtick and held above his head; and when the maſter ſtands ſtill the ſtick is ſet down, it having a foot to ſtand upon. They alſo ſhow their reſpect by lifting their hands to the head; and therefore, when they receive a letter from any one for whom they have a great reſpect, they immediately hold it up to their heads, and ſometimes lay it upon their heads.

8 Genius and diſpoſitions.

They are eſteemed an ingenious people, and though rather indolent than active in diſpoſition, they are not addicted to the voluptuous vices which often accompany a ſtate of eaſe, being remarkably chaſte and temperate, and even holding drunkenneſs in abhorrence.—They are, however, accounted inſolent towards their inferiors, and equally obſequious to thoſe above them; the latter of which qualities appears to be particularly inculcated from their earlieſt youth. In general, their behaviour is extremely modeſt, and they are averſe to loquacity. Like the Chineſe, they avoid ſpeaking in the firſt perſon; and when they addreſs a lady, it is always with ſome reſpectful epithet, inſinuating perſonal accompliſhments.

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No man in this country learns any particular trade, but has a general knowledge of all that are commonly practiſed, and every one works ſix months for the king by rotation; at which time, if he ſhould be found perfectly ignorant of the buſineſs he is ſet about, he is doomed to ſuffer the baſtinado. The conſequence of this burdenſome ſervice is, that no man endeavours to excel in his buſineſs, leſt he ſhould be obliged to practiſe it as long as he lives for the benefit of the crown.

9 Government.

The government of this country is extremely oppreſſive, the king being not only ſovereign but proprietor of all the lands, and chief merchant likewiſe; by which means he monopolizes almoſt the whole traffic, to the great prejudice of his ſubjects. The crown is ſaid to be hereditary, but it is often transferred by revolutions, on account of the exorbitant abuſe of power in thoſe who exerciſe the royal office. In his palace, the king is attended by women, who not only prepare his food, and wait on him at table, but even perform the part of valets, and put on all his clothes, except his cap, which is conſidered as too ſacred to be touched by any hand but his own. He ſhows himſelf to the people only twice a-year, when he diſtributes his alms to the talapoins or prieſts; and on thoſe occaſions he always appears in an elevated ſituation, or mounted on the back of an elephant. When he takes the diverſion of hunting, he is as uſual attended by his women on foot, preceded by a guard of 200 men, who drive all the people from the roads through which they are to paſs; and when the king ſtops, all his attendants fall upon their faces on the ground.

10 Forms of proceſs.

All their proceedings in law are committed to writing, and none is ſuffered to exhibit a charge againſt another, without giving ſecurity to proſecute it, and anſwer the damages if he does not prove the fact againſt the perſon accuſed. When a perſon intends to proſecute another, he draws up a petition, in which he ſets forth his complaint, and preſents it to the *nai*, or head of the band to which he belongs, who tranſmits it to the governor; and if the complaint appears frivolous, the proſecutor, according to the laws of the country, ſhould be puniſhed; but the magiſtrates generally encourage proſecutions on account of the perquiſites they bring to their office.

Every thing being prepared for hearing, the parties are ſeveral days called into court, and perſuaded to agree; but this appears to be only a matter of form. At length the governor appoints a day for all parties to attend; and being come into court, the clerk reads the proceſs and opinion of his aſſociates, and then the governor examines upon what reaſons their opinions are founded; which being explained to him, he proceeds to paſs judgment.

11 Trial by ordeal.

When ſufficient proofs are wanting, they have recourſe to an ordeal trial, like that of our Saxon anceſtors: both the plaintiff and the defendant walk upon burning coals, and he that eſcapes unhurt is adjudged to be in the right: ſometimes the proof is made by putting their hands in boiling oil; and in both theſe trials, by ſome peculiar management, one or the other is ſaid to remain unhurt. They have alſo a proof by water,

in

Siam. is which he who remains longeſt under it is eſteemed innocent. They have another proof, by ſwallowing pills, which their prieſts adminiſter with ſevere imprecations; and the party who keeps them in his ſtomach without vomiting is thought to be innocent.

All theſe trials are made in the preſence of the magiſtrates and people; and the king himſelf frequently directs them to be performed, when crimes come before him by way of appeal. Sometimes he orders both the informer and priſoner to be thrown to the tigers: and the perſon that eſcapes by his not being ſeized upon by thoſe beaſts, is ſufficiently juſtified.

12 Religious opinions. They maintain the doctrine of tranſmigration, believing in a pre-exiſtent ſtate, and that they ſhall paſs into other bodies till they are ſufficiently purified to be received into paradiſe. They believe likewiſe that the ſoul is material, but not ſubject to the touch; that it retains the human figure after quitting a body of that ſpecies; and that when it appears to perſons with whom it was acquainted, which they ſuppoſe it to do, the wounds of one that has been murdered will then be viſible. They are of opinion that no man will be eternally puniſhed; that the good, after ſeveral tranſmigrations, will enjoy perpetual happineſs; but that thoſe who are not reformed will be doomed to tranſmigration to all eternity. They believe in the exiſtence of a Supreme Being; but the objects of their adoration are departed ſaints, whom they conſider as mediators or interceſſors for them; and to the honour of this numerous tribe both temples and images are erected.

13 Marriages. The men of this country are allowed a plurality of women; but excepting one, who is a wife by contract, the others are only concubines, and their children deemed incapable of any legal inheritance. Previous to every nuptial contract, an aſtrologer muſt be conſulted, who calculates the nativity of the parties, and determines whether their union is likely to prove fortunate or otherwiſe. When his prognoſtication is favourable, the lover is permitted to viſit his miſtreſs three times, at the laſt of which interviews the relations being preſent, the marriage portion is paid, when, without any religious ceremony performed, the nuptials are reckoned complete, and ſoon after conſummated. A few days after the talapoin viſits the married couple, ſprinkles them with water, and repeats a prayer for their proſperity.

14 Funerals. The practice in Siam reſpecting funerals, is both to burn and bury the dead. The corpſe being laid upon the pile, it is ſuffered to burn till a conſiderable part is conſumed, when the remainder is interred in a burying-place contiguous to ſome temple. The reaſon which they give for not burning it entirely to aſhes is, that they ſuppoſe the deceaſed to be happy when part of his remains eſcapes the fire. Inſtead of a tombſtone, they erect a pyramid over the grave. It formerly was the cuſtom to bury treaſure with the corpſe; but longer experience evincing, that the ſacrilegious light in which robbing the graves was conſidered did not prevent the crime, they now diſcontinue the ancient practice, and inſtead of treaſure bury only painted papers and other triſles.

15 Rivers. The two principal rivers are the Menan and the Mecon, which riſe in the mountains of Tartary, and run to the ſouth; the former paſſing by the city of Siam, falls into the bay of the ſame name, in the 13th degree of north latitude; and the latter running through Laos and Cambodia, diſcharges itſelf into the Indian ocean in the 9th degree of north latitude.

Siam || Siberia.

16 Deſcription of the capital. The capital of the country is Siam, called by the natives *Siyothoya*, ſituated in the 101ſt degree of eaſt longitude, and in the 14th degree of north latitude, being almoſt encompaſſed by the branches of the river Menan. It is about 10 miles in circumference within the walls, but not a ſixth part of the ground is occupied by buildings. In the vacant ſpaces there are near 300 pagodas or temples, round which are ſcattered the convents of the prieſts and their burying-places. The ſtreets of the city are ſpacious, and ſome have canals running through them, over which is a great number of bridges. The houſes ſtand on pillars of the bamboo cane, and are built of the ſame materials; the communication between different families, during the winter ſeaſon, being carried on as in other tropical countries by means of boats. The grounds belonging to the ſeveral tenements are ſeparated by a palliſado, within which the cattle are houſed in barns, erected likewiſe upon pillars, to preſerve them from the annual inundation.

SIBBALDIA, in botany: A genus of plants belonging to the claſs of pentandria, and to the order of pentagynia; and in the natural ſyſtem arranged under the 35th order, *Senticoſæ*. The calyx is divided into ten ſegments. The petals are five, and are inſerted into the calyx. The ſtyles are attached to the ſide of the germens. The ſeeds are five. There are three ſpecies belonging to this genus, the *procumbens*, *erecta*, and *altaica*. The procumbens, or reclining ſibbaldia, is a native of North Britain, having never been diſcovered in the ſouthern parts of the iſland. It grows on Ben-Lomond and Ben-Mor, within a mile of the ſummit. It is diſtinguiſhed by a procumbent or trailing ſtem; by three leaves growing on the top of a ſmall footſtalk, which are trifid at the extremity, and ſomewhat hairy. The flowers are yellow, and bloſſom in July or Auguſt.

SIBENICO, or Sebenico, the name of a city and province of Dalmatia. The province of Sibenico runs along the ſea for more than 30 miles; reaches in ſome places above 20 miles within land, and comprehends above 70 iſlands. The city of Sibenico is ſituated near the mouth of the river Cherca, in the Gulf of Venice, 33 miles north of Spalatto, and 25 ſouth-eaſt of Zara. E. Long. 16° 46′, N. Lat. 44° 17′. It belongs to the Venetians. It is defended on one ſide by a caſtle, which held out againſt repeated attacks of the Turks, and towards the ſea by a fort.

1 Boundaries and extent. SIBERIA, a large country, comprehending the moſt northerly parts of the Ruſſian empire in Aſia. It is bounded on the eaſt by the eaſtern ocean; on the ſouth by Great Tartary; on the weſt by Ruſſia; and on the north by the Frozen Ocean. It is about 2000 miles in length from eaſt to weſt, and 750 miles in breadth from north to ſouth.

2 Conquered by the Ruſſians. At what time this country was firſt inhabited, or by whom it was peopled, we are entirely ignorant; but writings have been found in it when it was diſcovered, which ſhows that it muſt have been early known to a civilized people†. The Ruſſians, from whom we have received our knowledge, knew nothing of it before the middle of the 16th century. In the reign of John Baſilowitz I. indeed, an incurſion had been made into Siberia,

† *Bell's Travels.*

Siberia.

and ſome Tartar tribes ſubdued: but theſe conqueſts were not permanent; and we hear of no further communication between Ruſſia and Siberia till the time of John Baſilowitz II. It was opened again at that time by means of one Anika Strogonoff, a Ruſſian merchant who had eſtabliſhed ſome ſalt-works at a town in the government of Archangel. This man carried on a trade with the inhabitants of the north-weſt parts of Siberia, who brought every year to the town abovementioned large quantities of the fineſt furs. Thus he acquired a very conſiderable fortune in a ſhort time; when at laſt the czar, perceiving the advantages which would accrue to his ſubjects from having a regular intercourſe with Siberia, determined to enlarge the communication which was already opened. With this view he ſent into Siberia a body of troops, which croſſed the Yugorian mountains, that form part of the north-eaſtern boundary of Europe. They ſeem, however, not to have paſſed the Irtiſh, or to have penetrated farther than the weſtern branch of the river Oby. Some Tartar tribes were laid under contribution, and a chief named *Yediger* conſented to pay an annual tribute of 1000 ſables. But this produced no laſting advantage to Ruſſia; for, ſoon after, Yediger was defeated and taken priſoner by Kutchum Khan, a deſcendant of the great Jenghiz Khan: and thus the allegiance of this country to Ruſſia was diſſolved.

For ſome time we hear of no further attempts made by the Ruſſians on Siberia; but in 1577 the foundation of a permanent conqueſt was laid by one Yermac Temofeeff, a Coſſack of the Don. This man was at firſt the head of a party of banditti who infeſted the Ruſſians in the province of Caſan; but being defeated by the troops of the czar, he retired with 6000 of his followers into the interior parts of that province. Continuing his courſe ſtill eaſtward, he came to Orel, the moſt eaſterly of all the Ruſſian ſettlements. Here he took up his winter-quarters: but his reſtleſs genius did not ſuffer him to continue for any length of time in a ſtate of inactivity; and from the intelligence he procured concerning the ſituation of the neighbouring Tartars of Siberia, he turned his arms towards that quarter.

3 State of Siberia at the time of the Ruſſian conqueſt.

Siberia was at that time partly divided among a number of ſeparate princes, and partly inhabited by the various tribes of independent Tartars. Of the former Kutchum Khan was the moſt powerful ſovereign. His dominions conſiſted of that tract of country which now forms the ſouth-weſtern part of the province of Tobolſk; and ſtretched from the banks of the Irtiſh and Oby to thoſe of the Tobol and Tura. His principal reſidence was at Sibir, a ſmall fortreſs upon the river Irtiſh, not far from the preſent town of Tobolſk, and of which ſome ruins are ſtill to be ſeen. After a courſe of unremitted fatigue, and a ſeries of victories which almoſt exceed belief, but of which we have not room to give the detail, our intrepid adventurer diſpoſſeſſed this prince of his dominions, and ſeated himſelf on the throne of Sibir. The number of his followers, however, being greatly reduced, and perceiving he could not depend on the affection of his new ſubjects, he had recourſe to the czar of Muſcovy, and made a tender of his new acquiſitions to that monarch, upon condition of receiving immediate and effectual ſupport. This propoſal was received with the greateſt ſatisfaction by the czar; who granted him a pardon for all former offences, and ſent him the required ſuccours. Yermac, however, being ſoon after drowned in an unſucceſsful excurſion, the Ruſſians began to loſe their footing in the country. But freſh reinforcements being ſeaſonably ſent, they not only recovered their ground, but puſhed their conqueſts far and wide; wherever they appeared, the Tartars were either reduced or exterminated. New towns were built, and colonies were planted on all ſides. Before a century had well elapſed, all that vaſt tract of country now called *Siberia*, which ſtretches from the confines of Europe to the Eaſtern Ocean, and from the Frozen Sea to the preſent frontiers of China, was annexed to the Ruſſian dominions.

Siberia.

4 Climate.

The air of Siberia is, in general, extremely piercing, the cold there being more ſevere than in any other part of the Ruſſian dominions. The Siberian rivers are frozen very early, and it is late in the ſpring before the ice is thawed (A). If the corn does not ripen in Auguſt, there is little hope of a harveſt in this country; and in the province of Jeniſeiſk it is ſometimes covered with ſnow before the peaſants can reap it. To defend the inhabitants againſt this extreme ſeverity of the climate, Providence ſeems more liberally to have dealt out to them wood for fuel and furs for clothing. As the winter's day in the north parts of Siberia laſt but a few hours, and the ſtorms and flakes of ſnow darken the air ſo much, that the inhabitants, even at noon, cannot ſee to do any thing without artificial lights, they ſleep away the greateſt part of that ſeaſon.

Theſe

(A) M. Gmelin, M. Muller, and two other philoſophers, ſet out in the year 1733 to explore the dreary regions of Siberia, by deſire of the empreſs Anne of Ruſſia. After ſpending nine years and a half in obſerving every thing that was remarkable, they returned to Peterſburgh; and an account of this journey was publiſhed by M. Gmelin. In order to examine how far the froſt had penetrated into the ground, M. Gmelin, on the 18th of June, at a place called Jacutia, ordered the earth to be dug in high ground; they found mould to the depth of 11 inches, under which they met with looſe ſand to two feet and a half further, after which it grew harder, and at half a foot deeper ſo hard as ſcarce to give way to the tools; ſo that the ground ſtill remained unthawed at not leſs than the depth of four feet. He made the ſame experiment in a lower ſituation; the ſoil was 10 inches deep, after that a looſe ſand for two feet and ten inches, below which all was frozen and hard. At Jacutia the inhabitants preſerve in cellars ſeveral ſorts of berries, which they reckon among their dainties, perfectly good and freſh the whole year, though theſe cellars are ſcarce a fathom deep. At the fortreſs of Argun, in little more than 50 degrees of latitude, the inhabitants relate that the earth in many places is never thawed above a yard and half, and that the internal cold of the earth will ſcarce permit a well to be dug, of which they bring an inſtance that happened not long before the author's arrival at that place. They deſigned to ſink a well near a houſe at

ſome

Siberia.

These ſevere winters are rapidly ſucceeded by ſummers, in which the heat is ſo intenſe that the Tunguſians, who live in the province of Jakutſk, go almoſt naked. Here is ſcarcely any night during that ſeaſon; and towards the Frozen Ocean the ſun appears continually above the horizon. The vegetables and fruits of the earth are here extremely quick in their growth.

5 Soil and produce.

The whole track of land beyond the 60th degree of north latitude is a barren waſte; for the north part of Siberia yields neither corn nor fruits; though barley is known frequently to come to perfection in Jakutſk.—For this reaſon, the inhabitants of the northern parts are obliged to live on fiſh and fleſh, but the Ruſſians are ſupplied with corn from the ſouthern parts of Siberia, where the ſoil is ſurpriſingly fertile. The countries beyond the lake of Baikal, eſpecially towards the eaſt, as far as the river Argun, are remarkably fruitful and pleaſant; but ſuch is the indolence of the inhabitants, that ſeveral fine tracts of land, which would make ample returns to the peaſant for cultivating them, lie neglected. The paſtures are excellent in this country, which abounds in fine horned cattle, horſes, goats, &c. on which the Tartars chiefly depend for ſubſiſtence. However, there are ſeveral ſteppes, or barren waſtes, and unimprovable tracts in theſe parts; and not a ſingle fruit tree is to be ſeen. There is great variety of vegetables, and in ſeveral places, particularly near Kraſnaia Sloboda, the ground is in a manner overrun with aſparagus of an extraordinary height and delicious flavour. The bulbs of the Turkiſh bundes, and other ſorts of *lilies*, are much uſed by the Tartars inſtead of bread. This want of fruit and corn is richly compenſated by the great quantities of wild and tame beaſts, and fowls, and the infinite variety of fine fiſh which the country affords (B.)

Siberia.

In that part of Siberia which lies near the Ice Sea, as well as in ſeveral other places, are woods of pine, larch, and other trees; beſides which, a conſiderable quantity of wood is thrown aſhore by the waves of the Ice Sea; but whence it comes is not yet aſcertained.

6 Wild beaſts.

Beſides the wild fowl with which Siberia abounds, there is a prodigious number of quadrupeds, ſome of which are eatable, and others valuable for their ſkins or furs.

The animals moſt valued for their ſkins are the black fox,

ſome diſtance from the river Argun, for which purpoſe they thawed the earth by degrees, and dug ſome fathoms till they had penetrated a fathom and half below the level of the river, but found no ſpring. Hence perhaps we may venture to aſſert, that beſides the great elevation of the earth in theſe countries, there is another cauſe, perhaps latent in the earth itſelf, of this extraordinary cold, naturally ſuggeſted to us by conſidering the cavity of an old ſilver mine at Argun, which being exhauſted of its ore, now ſerves the inhabitants in ſummer time for a cellar to keep their proviſions: this place is ſo extremely cold as to preſerve fleſh meats from putrefaction in the hotteſt ſummers, and to ſink the mercury in de Liſle's thermometer to 146 and 147. The author travelling from Nerſchoi towards Argun, to viſit the works of the ſilver mines in that place, Auguſt 1735, came to the river Orkija, near Soloniſchaia, on July the 1ſt, from whence he arrived a little before dark at the village of Seventua, diſtant from the river 27 leagues. In this journey he and his fellow travellers for more than four leagues felt it vaſtly cold; ſoon after they came into a warm air, which continued ſome leagues; after which the cold returned; and thus are travellers ſubjected to perpetual viciſſitudes of warmth and cold. But it is obſerved, in general, that the eaſtern parts are colder than the weſtern, though ſituated in the ſame latitude; for as in thoſe eaſtern regions ſome tracts of land are much colder than the reſt, their effects muſt be felt by the neighbouring parts. And this conjecture is favoured by the thermometrical obſervations made with M. de L'Iſle's inſtrument in all parts of Siberia, in which the mercury was depreſſed to the 226th degree, even in thoſe parts that lie very much towards the ſouth, as in the territory of Selinga, which ſaid degree anſwers in Fahrenheit's thermometer to about 55.5 below 0, but the ſame thermometer ſometimes indicated a much greater cold. At the fort of Kiringa, on Feb. 10. 1738, at 8 in the morning, the mercury ſtood at 240, which anſwers nearly to 72 below 0 in Fahrenheit's. On the 23d of the ſame month it was a degree lower. At the ſame place, December 11. at three in the afternoon, it ſtood at 254 in De Liſle's thermometer, and very near 90 in Fahrenheit's; on December 29. at four in the afternoon, at 263; on November 27. at noon, at 270; January 9. at 275, which ſeveral depreſſions anſwer in Fahrenheit's to 99.44, 107.73, and 113.65; on January 5. at 5 in the morning, at 262, an hour after at 281, but at eight o'clock it returned to 250, and there remained till 6 in the afternoon, and then roſe by degrees till an hour before midnight, when it ſtood at 202. So that the greateſt depreſſion of the mercury anſwers in Fahrenheit's thermometer to 120.76 degrees below 0, which is indeed very ſurpriſing, and what no body ever imagined before. While this cold laſted at Jeniſea, the ſparrows and magpies fell to the ground, ſtruck dead, as it were, with the froſt, but revived if they were ſoon brought into a warm room. The author was told alſo that numbers of wild beaſts were found in the woods dead and ſtiff with the froſt, and ſeveral travellers had their blood and juices quite frozen in their veſſels. The air itſelf at that time was ſo diſmal, that you would think it changed to ice, as it was a thick fog, which was not diſſipable by any exhalations, as in the ſpring and autumn, and the author could ſcarce ſtand three minutes in the porch of his houſe for the cold.

(B) The oak, though frequent in Ruſſia, it is ſaid, is not to be found through this vaſt region nearer than the banks of the Argun and Amur, in the dominions of China. The white poplar, the aſpen, the black poplar, the common ſallow, and ſeveral ſpecies of the willow, are very common. The Norway and ſilver fir form great foreſts; but the former does not grow beyond the 60th degree of north latitude, and the latter not beyond 58 degrees. To this dreary region of Siberia, Europe is indebted for that excellent ſpecies of oats called *Avena Sibirica*, and our gardens are enlivened with the gay and brilliant flowers brought from the ſame country.

Siberia. fox, the ſable, the hyæna, the ermine, the ſquirrel, the beaver, and the lynx. The ſkin of a real black fox is more eſteemed than even that of a ſable. In the country near the Frozen Ocean are alſo blue and white foxes. The fineſt ſables come from Nertſhinſk and Jakutſk, the inhabitants of which places catch them in the mountains of Stannowoi Krebet. The tributary nations were formerly obliged to pay their taxes in the ſkins of foxes and ſables only. But now the ſkins of ſquirrels, bears, rein-deer, &c. and ſometimes money, are received by way of tribute; and this not only from thoſe who live near the Lena, but alſo in the governments of Ilinſk, Irkutzk, Selenginſk, and Nertſhinſk. When the Tartars firſt became tributary to Ruſſia, they brought their furs indiſcriminately as they caught them, and among them were often ſables of extraordinary value; and formerly, if any trader brought with him an iron kettle, they gave him in exchange for it as many ſables as it would hold. But they are now better acquainted with their value. They ſell their ſables to ſmugglers at a very high price, and pay only a ruble inſtead of a ſkin to the revenue officers, who now receive more ready money than ſables, by way of tribute. The ſubjects plead the ſcarcity of furs, and indeed not without ſome appearance of truth.

7 Minerals. Siberia has ſtill other and more valuable treaſures than thoſe we have yet mentioned. The ſilver mines of Argun are extremely rich; the ſilver they produce yield ſome gold, and both of theſe are found among the copper ore of Koliwan. This country is alſo particularly rich in copper and iron ore. The former lies even upon the ſurface of the earth; and conſiderable mines of it are found in the mountains of Pictow, Koliwan, Ploſkau, Woſkereſenſk, Kuſwi, Alepaik, and ſeveral others, and in the government of Kraſnoiarſk (c). Iron is ſtill more plentiful in all theſe places, and very good; but that of Kamenſki is reckoned the beſt. Several hundred thouſand puds of theſe metals are annually exported from the ſmelting houſes, which belong partly to the crown, and partly to private perſons. Moſt of them lie in the government of Catharinenburg. The Tartars alſo extract a great quantity of iron from the ore.

8 Precious ſtones. The topazes of Siberia have a fine luſtre, and in open ſandy places, near the river Argun, as well as on the banks of other rivers and lakes, are found ſingle ſmall pieces of agate. Here are alſo cornelians and green jaſper with red veins. The latter is chiefly met with in the deſerts of Gobiſkoi.

9 Marienglas. The famous marienglas, or lapis ſpecularis, great quantities of which are dug up in Siberia, is by ſome called Muſcovy or Ruſſian glaſs; and by others, though with leſs propriety, iſinglaſs. It is a particular ſpecies of tranſparent ſtone, lying in ſtrata like ſo many ſheets of paper. The matrix, or ſtone in which it is found, is partly a light yellow quartz, or marcaſſia, and partly a brown indurated fluid; and this ſtone contains in it all the ſpecies of the marienglas. To render the marienglas fit for uſe, it is ſplit with a thin two-edged knife; but care is taken that the laminæ be not too thin. It is uſed for windows and lanterns all over Siberia, and indeed in every part of the Ruſſian empire, and looks very beautiful; its luſtre and clearneſs ſurpaſſing that of the fineſt glaſs, to which it is particularly preferable for windows and lanterns of ſhips, as it will ſtand the exploſion of cannon. It is found in the greateſt plenty near the river Witim. Siberia.

10 Magnets. Siberia affords magnets of an extraordinary ſize, and even whole mountains of loadſtone. Pit-coal is alſo dug up in the northern parts of this country. The kamennoe maſlo, a yellowiſh kind of alum, unctuous and ſmooth to the touch, like tophus, is found in the mountains of Kraſnoiarſk, Ural, Altaiſh, Jeniſea, Baikal, Barguſik, Lena, and ſeveral others in Siberia.

11 Salt lakes and ſprings. In this country are not only a great number of freſh water lakes, but likewiſe ſeveral whoſe waters are ſalt; and theſe reciprocally change their nature, the ſalt ſometimes becoming freſh, and the freſh changing into ſaline. Some lakes alſo dry up, and others appear where none were ever ſeen before. The ſalt lake of Yamuſha, in the province of Tobolſk, is the moſt remarkable of all, for it contains a ſalt as white as ſnow, conſiſting entirely of cubic cryſtals. One finds alſo in Siberia ſaline ſprings, ſalt water brooks, and a hill of ſalt.

12 Curioſities. Siberia affords many other things which deſerve notice. That uſeful root called rhubarb grows in vaſt quantities near the city of Seleginſk. The curious mamuth's bones and horns, as they are called, which are found along the banks of the Oby, Jeneſei, Lena, and Irtiſh, are unqueſtionably the teeth and bones of elephants. But whether theſe elephants teeth and bones were conveyed to theſe northern regions by the general deluge, or by any other inundation, and were by degrees covered with earth, is a point which might lead us into long and very fruitleſs diſquiſitions; we ſhall therefore only obſerve, that ſuch bones have likewiſe been found in Ruſſia, and even in ſeveral parts of Germany. A kind of bones of a ſtill larger ſize than theſe have alſo been dug up in Siberia, and ſeem to have belonged to an animal of the ox kind. The horn of the whale called *narwhal* has been found in the earth near the rivers Indigiika and Anadir; and the teeth of another ſpecies of whales, called Wolroſs, about Anadirſkoi. The latter are larger than the common ſort, which are brought from Greenland, Archangel, and Kola.

13 Mountains. The chain of Siberian mountains reaches from that of Werchoturie towards the ſouth as far as the neighbourhood of the city of Orienburg, in a continued ridge, under the name of the Uralian mountains; but from thence it alters its direction weſtward. Theſe mountains are a kind of boundary between Ruſſia Proper and Siberia. Another chain of hills divides Siberia from the country of the Calmucks and Mongalians.—Theſe mountains, between the rivers Irtiſh and Oby, are called the Attaic or Golden Mountains, which name they afterwards loſe, particularly between the river Jeneſei and the Baikal lake, where they are called the Sayanian mountains.

The

(c) The copper mines of Koliwan, from which gold and ſilver are extracted, employ above 40,000 people. The ſilver mines of Nertſhinſk, beyond lake Baikal, employ above 14,000. The whole revenue ariſing from theſe mines, according to Mr Coxe, is not leſs than L. 679,182, 13 s.

Sibthorpia, Sibyls. 14 Inhabitants.

The inhabitants of Siberia conſiſt of the Aborigines or ancient inhabitants, the Tartars, and Ruſſians.

Some of theſe nations have no other religion but that of nature; others are Pagans or Mahometans, and ſome of them have been converted to Chriſtianity, or rather only baptiſed by the Ruſſian miſſionaries.

SIBTHORPIA, in botany: A genus of plants belonging to the claſs of didynamia, and to the order of angioſpermia; and in the natural ſyſtem claſſed with thoſe the order of which is doubtful. The calyx is ſpreading, and divided into five parts, almoſt to the baſe. The corolla is divided into five parts in the ſame manner, which are rounded, equal, ſpreading, and of the length of the calyx. The ſtamina grow in pairs at a diſtance from each other. The capſule is compreſſed, orbicular, bilocular, the partition being tranſverſe.—There are two ſpecies, the *europæa* and *evolvulacea*. The *europæa*, or baſtard money-wort, is a native of South Britain. The ſtems of it are ſlender, and creeping. The leaves are ſmall, round, and notched. The flowers grow under the wings of the leaves, are ſmall, and of a pale red colour. It bloſſoms from July to September, and is found in Cornwall on the banks of rivulets.

SIBYLS, in pagan antiquity, certain women ſaid to have been endowed with a prophetic ſpirit, and to have delivered oracles, ſhowing the fates and revolutions of kingdoms. Their number is unknown. Plato ſpeaks of one, others of two, Pliny of three, Ælian of four, and Varro of ten; an opinion which is univerſally adopted by the learned. Theſe ten Sibyls generally reſided in the following places, Perſia, Libya, Delphi, Cumæ in Italy, Erythræa, Samos, Cumæ in Æolia, Marpeſſa on the Helleſpont, Ancyra in Phrygia, and Tiburtis. The moſt celebrated of the Sibyls is that of Cumæ in Italy, whom ſome have called by the different names of Amalthæa, Demiphile, Herophile, Daphne, Manto Phemonoe, and Deiphobe. It is ſaid, that Apollo became enamoured of her, and that to make her ſenſible of his paſſion he offered to give her whatever ſhe ſhould aſk. The Sibyl demanded to live as many years as ſhe had grains of ſand in her hand, but unfortunately forgot to aſk for the enjoyment of the health, vigour, and bloom, of which ſhe was then in poſſeſſion. The god granted her requeſt, but ſhe refuſed to gratify the paſſion of her lover, though he offered her perpetual youth and beauty. Some time after ſhe became old and decrepit, her form decayed, melancholy paleneſs and haggard looks ſucceeded to bloom and cheerfulneſs. She had already lived about 700 years when Æneas came to Italy, and, as ſome have imagined, ſhe had three centuries more to live before her years were as numerous as the grains of ſand which ſhe had in her hand. She gave Æneas inſtructions how to find his father in the infernal regions, and even conducted him to the entrance of hell. It was uſual for the Sibyl to write her prophecies on leaves, which ſhe placed at the entrance of her cave; and it required particular care in ſuch as conſulted her to take up theſe leaves before they were diſperſed by the wind, as their meaning then became incomprehenſible. According to the moſt authentic hiſtorians of the Roman republic, one of the Sibyls came to the palace of Tarquin the Second, with nine volumes, which ſhe offered to ſell for a very high price. The monarch diſregarded her, and ſhe immediately diſappeared, and ſoon after returned, when ſhe had burned three of the volumes. She aſked the ſame price for the remaining ſix books; and when Tarquin refuſed to buy them, ſhe burned three more, and ſtill perſiſted in demanding the ſame ſum of money for the three that were left.—This extraordinary behaviour aſtoniſhed Tarquin; he bought the books, and the Sibyl inſtantly vaniſhed, and never after appeared to the world. Theſe books were preſerved with great care by the monarch, and called the Sibylline verſes. A college of prieſts was appointed to have the care of them; and ſuch reverence did the Romans entertain for theſe prophetic books, that they were conſulted with the greateſt ſolemnity, and only when the ſtate ſeemed to be in danger. When the capitol was burnt in the troubles of Sylla, the Sibylline verſes which were depoſited there periſhed in the conflagration; and to repair the loſs which the republic ſeemed to have ſuſtained, commiſſioners were immediately ſent to different parts of Greece to collect whatever verſes could be found of the inſpired writings of the Sibyls. The fate of theſe Sibylline verſes which were collected after the conflagration of the capitol is unknown. There are now many Sibylline verſes extant, but they are reckoned univerſally ſpurious; and it is evident that they were compoſed in the ſecond century by ſome of the followers of Chriſtianity, who wiſhed to convince the heathens of their error, by aſſiſting the cauſe of truth with the arms of pious artifice.

Lemprière's Dictionary.

Sicera || Sicily.

SICERA, a name given to any inebriating liquor by the Helleniſtic Jews. St Chryſoſtom, Theodoret, and Theophilus of Antioch, who were Syrians, and who therefore ought to know the ſignification and nature of "ſicera," aſſure us, that it properly ſignifies palm-wine. Pliny acknowledges, that the wine of the palm tree was very well known through all the eaſt, and that it was made by taking a buſhel of the dates of the palm-tree, and throwing them into three gallons of water; then ſqueezing out the juice, it would intoxicate like wine. The wine of the palm tree is white: when it is drunk new, it has the taſte of the cocoa, and is ſweet as honey. When it is kept longer, it grows ſtrong, and intoxicates. After long keeping, it becomes vinegar.

SICILIAN, in muſic, denotes a kind of gay ſprightly air, or dance, probably invented in Sicily, ſomewhat of the nature of an Engliſh jig; uſually marked with the characters $\frac{6}{8}$, or $\frac{12}{8}$. It conſiſts of two ſtrains; the firſt of four, and the ſecond of eight, bars or meaſures.

SICILY, is a large iſland in the Mediterranean Sea, adjoining to the ſouthern extremity of Italy, and extends from latitude 36° 25′ to latitude 38° 25′, and from longitude 12° 50′ to longitude 16° 5′ eaſt from London. Its greateſt length 210 miles, breadth 133, circumference 600; its form triangular, the three angles being the promontories of Pelorum, Pachynum, and Lilybæum, or as they are now called the Faro, Capo Paſſaro, and Capo Boco. It is divided from Italy by the ſtraits of Meſſina, reaching from the Tower of Faro, which is the moſt northerly part of the iſland, to the *Capo dell' Armi*, or the Cape of Arms, the moſt ſouthern part of Calabria. Theſe ſtraits, by the Latins called *Fretum Siculum*, by the Italians *Il Fare di Meſſina*, and by us the *Fare of Meſſina*, are between 12 and 15 miles over in the broadeſt places, and in the narroweſt about a mile and an half; inſomuch that when

1 Boundaries and extent.

4 Meſſina

Sicily. Meſſina was taken by the Carthaginians, many of the inhabitants are ſaid to have ſaved themſelves by ſwimming to the oppoſite coaſts of Italy. Hence has ariſen an opinion that the iſland of Sicily was originally joined to the continent, but afterwards ſeparated by an earthquake or ſome other natural cauſe. This ſeparation, however, is reckoned by the moſt judicious among the ancients to be fabulous; and they content themſelves with ſpeaking of it as a thing ſaid to have happened.

2 Hiſtory during the fabulous ages. Anciently this iſland was called *Sicania*, *Sicilia*, and *Trinacria* or *Triquetra*; the two former it had from the Sicani and Siculi, who peopled a conſiderable part of the country; the two latter from its triangular figure. Its firſt inhabitants, according to the moſt reſpectable ancient authors, were the Cyclopes and Læſtrigones, who are ſaid to have ſettled in the countries adjoining to Mount Etna; but of their origin we know nothing, except what is related by the poets. After them came the Sicani, who called themſelves the original inhabitants of the country; but ſeveral ancient hiſtorians inform us that they came from a country in Spain watered by the river Siconus. Diodorus, however, is of opinion, that the Sicani were the moſt ancient inhabitants of this iſland. He tells us that they were in poſſeſſion of the whole, and applied themſelves to cultivate and improve the ground in the neighbourhood of Etna, which was the moſt fruitful part of the iſland: they built ſeveral ſmall towns and villages on the hills to ſecure themſelves againſt thieves and robbers; and were governed, not by one prince, but each city and diſtrict by its own king. Thus they lived till Etna began to throw out flames, and forced them to retire to the weſtern parts of the iſland, which they continued to inhabit in the time of Thucydides. Some Trojans, after the deſtruction of their city, landed in the iſland, ſettled among the Sicani, and built the cities of Eryx and Egeſta, uniting themſelves with them, and taking the general name of Elymi or Elymæi. They were afterwards joined by ſome Phocenſes, who ſettled here on their return from the ſiege of Troy.

After the Sicani had for many ages enjoyed an undiſturbed poſſeſſion of the whole of Sicily, or ſuch parts of it as they choſe to inhabit, they were viſited by the Siculi, who were the ancient inhabitants of Auſonia properly ſo called; but being driven out from thence by the Opici, they took refuge in the iſland of Sicily. Not being contented with the narrow bounds allowed them by the Sicani, they began to encroach upon their neighbours; upon which a war enſuing, the Sicani were utterly defeated, and confined to a corner of the iſland, the name of which was now changed from *Sicania* into that of *Sicilia*.

About 300 years after the arrival of the Siculi, the iſland firſt began to be known to the Greeks, who eſtabliſhed various colonies, and built many cities in different parts of the iſland; and it is only from the time of their arrival that we have any hiſtory of the iſland. The firſt of the Greeks that came into Sicily were the Chalcidians of Eubœa, under the conduct of Thucles, who built Naxus, and a famous altar of Apollo, which, as Thucydides tells us, was ſtill ſtanding in his time without the city. The year after, which was, according to Dionyſius Halicarnaſſenſis, the third of the 17th Olympiad, Archias the Corinthian, one of the Heraclidæ, laid the foundations of Syracuſe. Seven years after, a new colony of Chalcidians founded Leontini and Catana, after having driven out the Siculi, who inhabited that tract. About the ſame time Lamis, with a colony from Megara, a city of Achaia, ſettled on the river Pantacius, at a place called *Trotilum*, where his adventurers lived ſome time in common with the Chalcidians of Leontini; but, being driven from thence by the Leontines, he built the city of Thapſus, where he died. Upon his death, the colony left Thapſus; and under the conduct of Hyblon king of the Siculi, founded Megara Hyblæa, where they reſided 245 years, till they were driven out by Gelon tyrant of Syracuſe. During their abode at Megara, they ſent one Pamilus, who was come from Megara in Achaia, their original city, to build Selinus. This city was founded about 100 years after the foundation of Megara. Antiphemus and Entimus, the former a Rhodian, the other a Cretan, led each a colony of their countrymen, and jointly built the city of Gela on a river of the ſame name, eſtabliſhing in their new ſettlement the Doric cuſtoms, about 45 years after the founding of Syracuſe. The inhabitants of Gela founded Agrigentum 103 years after their arrival in Sicily, and introduced the ſame cuſtoms there. A few years after, Zancle was built by the pirates of Cumæ in Italy; but chiefly peopled by the Chalcidians, Samians, and Ionians, who choſe rather to ſeek new ſettlements than live under the Perſian yoke. Some time after, Anaxales, tyrant of Rhegium, drove out the ancient proprietors; and, dividing his lands amongſt his followers, called the city *Meſſana* or *Meſſene*, which was the name of his native city in Peloponneſus. The city of Himera was founded by the Zancleans under the direction of Eucleides, Simus, and Sacon; but peopled by the Chalcidians and ſome Syracuſan exiles, who had been driven out by the contrary faction.

The Syracuſians built Acræ, Chaſmenæ, and Camarina; the firſt 70 years, the ſecond 90, and the third 135, after the foundation of their own city. This is the account which Thucydides, a moſt judicious and exact writer, gives us of the various nations, whether Greeks or Barbarians, who ſettled in Sicily. Strabo counts among the ancient inhabitants of Sicily the Morgetes, who being driven out of Italy by the Oenotrians, ſettled in that part of the iſland where the ancient city of Morgantium ſtood. The Campani, who aſſumed the name of *Mamertini*, that is, *invincible warriors*, and the Carthaginians, who ſettled very early in Sicily, ought likewiſe to be counted among the ancient inhabitants of the iſland.

Before this period the hiſtory of Sicily is blended with fables like the early hiſtory of almoſt every other country. After the ſettlement of the Greeks in the iſland, its various revolutions have been traced from their ſeveral ſources by many writers; but by none with greater accuracy than Mr Swinburne. From his account of his Travels in the Two Sicilies, we have therefore taken the following conciſe hiſtory of this kingdom, which will at once gratify ſuch of our readers as intereſt themſelves in the fate of a generous people who long ſtruggled in vain for freedom; and at the ſame time afford them a ſpecimen of the entertainment they may receive from the very elegant work of the author.

3 "Ari-

Sicily.

Swinburne's Travels in the Two Sicilies, vol ii. p. 176.

"Ariſtocracy prevailed at firſt in the Greek ſettlements, but ſoon made way for tyranny; which in its turn was expelled by democracy. One of the earlieſt deſtroyers of common liberty was Phalaris of Agrigentum, who reigned 600 years before Chriſt: his example was contagious; a legion of tyrants ſprang up, and not a commonwealth in the iſland eſcaped the laſh of an uſurper. Syracuſe was moſt oppreſſed and torn to pieces by diſſenſion; as its wealth and preponderance in the general ſcale held out a greater temptation than other cities to the ambition of wicked men. It requires the combined teſtimony of hiſtorians to enforce our belief of its wonderful proſperity, and the no leſs extraordinary tyranny of ſome of its ſovereigns. Theſe Grecian colonies attained to ſuch excellence in arts and ſciences as emboldened them frequently to vie with the learned and ingenious in the mother country; nay, often enabled them to bear away the palm of victory: there needs no ſtronger proof of their literary merits than a bare recital of the names of Archimedes, Theocritus, Gorgias, and Charondas.

3 Grecian colonies in Sicily.

4 Carthaginians conquers great part of it.

"But the Sicilian Greeks were not deſtined to enjoy the ſweets of their ſituation without moleſtation. Very ſoon after their arrival, the inhabitants of the neighbouring coaſt of Africa began to aſpire to a ſhare of Sicily. Carthage ſent large bodies of forces at different times to eſtabliſh their power in the iſland, and about 500 years before the Chriſtan era had made themſelves maſters of all the weſtern parts of it. The Siculi retained poſſeſſion of the midland country, and the ſouthern and eaſtern coaſts were inhabited by the Greeks.

5 Gelo choſen king.

"About that time Gelo was choſen prince of Syracuſe on account of his virtues, which grew ſtill more conſpicuous after his exaltation: had the example he ſet been followed by his ſucceſſors, the advantages of freedom would never have been known or wiſhed for by the Syracuſans. The Carthaginians found in him a vigorous opponent to their project of enſlaving Sicily, a project invariably purſued but never accompliſhed.

6 Is ſucceeded by Hiero.

"Hiero ſucceeded his brother Gelo, and, contrary to the uſual progreſſion, began his reign by a diſplay of bad qualities. Senſible of his error, and improved by experience, he afterwards adopted more equitable meaſures. At his death the Syracuſans threw off the yoke, and for ſixty years revelled in all the joys of freedom. Their peace was, however, diſturbed by the Athenians and the Carthaginians. The latter plundered Agrigentum, and threatened ruin to the reſt of the Grecian ſtates; but a treaty of peace averted that ſtorm. The Athenians, under pretence of ſupporting their allies the people of Segeſta, but in reality from a thirſt of dominion, inveſted Syracuſe with a formidable land and naval armament under the command of Nicias; in conſequence of a raſh indigeſted plan, ill conducted attacks, and inadequate ſupplies, their whole hoſt was cut to pieces or led away into captivity.

7 Dionyſius the elder and younger.

"Syracuſe had ſcarce time to breathe after her victory ere inteſtine wars broke out, and raiſed Dionyſius to ſupreme command. Avarice, deſpotiſm, and cruelty, marked every day of his reign; but his military enterpriſes were crowned with conſtant ſucceſs. He died in peace, and bequeathed a powerful ſovereignty to a ſon of his name tainted with the ſame and worſe vices, but not endowed with equal capacity and martial abilities

Sicily.

ty; in ſuch hands the rod of tyranny ceaſed to be formidable, and the tyrant was driven out of Sicily by the patriotic party; but matters were not ſufficiently ſettled for popular government, and Dionyſius reſumed the ſceptre for a while, till Timoleon forced him into perpetual exile."

8 Agathocles the tyrant.

Liberty ſeemed now to be eſtabliſhed on a permanent baſis; but in Syracuſe ſuch proſpects always proved illuſory. Agathocles, a tyrant more inhuman than any preceding uſurper, ſeized the throne, and deluged the country with blood. He was involved in a perilous conteſt with the Carthaginians, who obtained many advantages over him, drove his troops from port to port, and at laſt blocked up his capital. In this deſperate ſituation, when all foreign helps were precluded, and hardly a reſource remained at home, the genius of Agathocles compaſſed his deliverance by a plan that was imitated among the ancients by Hannibal, and among the moderns by the famous Cortes. He embarked with the flower of his army; forced his way through innumerable obſtacles; landed in Africa; and, having burnt his fleet, routed the Carthaginians in a pitched battle, and laid their territory waſte. Carthage ſeemed to be on the brink of ruin, and that hour might have marked her downfal had the Sicilian hoſt been compoſed of patriotic ſoldiers, and not of ungovernable aſſaſſins; diſcord pervaded the victorious camp, murder and riot enſued; and the tyrant, after beholding his children and friends butchered before his face, eſcaped to Sicily, to meet a death as tragical as his crimes deſerved.

9 Pyrrhus king of Epirus deceives the Sicilians.

Anarchy now raged throughout the iſland, and every faction was reduced to the neceſſity of calling in the aſſiſtance of foreign powers; among whom Pyrrhus king of Epirus took the lead, and reduced all parties to ſome degree of order and obedience. But ambition ſoon prompted him to invade thoſe rights which he came to defend; he caſt off the maſk, and made Sicily feel under his ſway as heavy a hand as that of its former oppreſſors; but the Sicilians ſoon aſſumed courage and ſtrength enough to drive him out of the iſland.

10 The Mamertini ſurpriſe Meſſina, and are aſſiſted by the Romans;

About this period the Mamertini, whom Mr Swinburne indignantly ſtyles a crew of miſcreants, ſurpriſed Meſſina, and, after a general maſſacre of the citizens, eſtabliſhed a republican form of government. Their commonwealth became ſo troubleſome a neighbour to the Greeks, that Hiero II. who had been raiſed to the chief command at Syracuſe in conſideration of his ſuperior wiſdom and warlike talents, found himſelf neceſſitated to form a league with Carthage, in order to deſtroy this neſt of villains. In their diſtreſs the Mamertini implored the aſſiſtance of Rome, though the ſenate had recently puniſhed with exemplary ſeverity one of their own legions for a ſimilar outrage committed at Rhegium. The virtue of the Romans gave way to the temptation, and the deſire of extending their empire beyond the limits of Italy, caſt a veil over every odious circumſtance attending this alliance. A Roman army croſſed the Faro, relieved Meſſina, defeated the Carthaginians, and humbled Hiero into an ally of the republic.

11 Which gives riſe to the firſt Punic war.

Thus began the firſt Punic war, which was carried on for many years in Sicily with various ſucceſs. The genius of Hamilcar Barcas ſupported the African cauſe under numberleſs diſappointments, and the repeated overthrows of his colleagues; at laſt, finding his exertions

Sicily.

12 The second Punic war raised by Hannibal.

tions ineffectual, he adviſed the Carthaginian rulers to purchaſe peace at the price of Sicily. Such a treaty was not likely to be obſerved longer than want of ſtrength ſhould curb the animoſity of the vanquiſhed party: when their vigour was recruited, Hannibal ſon of Hamilcar eaſily perſuaded them to reſume the conteſt, and for 16 years waged war in the heart of the Roman territories. Meanwhile Hiero conducted himſelf with ſo much prudence, that he retained the friendſhip of both parties, and preſerved his portion of Sicily in perfect tranquillity. He died in extreme old age, beloved and reſpected both at home and abroad.

His grandſon Hieronymus, forſaking this happy line of politics, and contracting an alliance with Carthage, fell an early victim to the troubles which his own folly had excited. Once more, and for the laſt time, the Syracuſans found themſelves in poſſeſſion of their independence: but the times were no longer ſuited to ſuch a ſyſtem; diſſenſions gained head, and diſtracted the public councils. Carthage could not ſupport them, or prevent Marcellus from undertaking the ſiege of Syracuſe, immortalized by the mechanical efforts of Archimedes, and the immenſity of the plunder. See SYRACUSE.

13 Sicily conquered by the Saracens, and afterwards by the Normans.

The Sicilians after this relinquiſhed all martial ideas, and during a long ſeries of generations turned their attention ſolely to the arts of peace and the labours of agriculture. Their poſition in the centre of the Roman empire preſerved them both from civil and foreign foes, except in two inſtances of a ſervile war. The rapacity of their governors was a more conſtant and inſupportable evil. In this ſtate of apathy and opulence Sicily remained down to the 7th century of our era, when the Saracens began to diſturb its tranquillity. The barbarous nations of the north had before invaded and ravaged its coaſts, but had not long kept poſſeſſion. The Saracens were more fortunate. In 827 they availed themſelves of quarrels among the Sicilians to ſubdue the country. Palermo was choſen for their capital, and the ſtandard of Mahomet triumphed about 200 years. In 1038 George Maniaces was ſent by the Greek emperor with a great army to attack Sicily. He made good his landing, and puſhed his conqueſts with vigour: his ſucceſs aroſe from the valour of ſome Norman troops, which were at that time unemployed and ready to ſell their ſervices to the beſt bidder. Maniaces repaid them with ingratitude; and by his abſurd conduct gave the Muſſulmen time to breathe, and the Normans a pretext and opportunity of invading the Imperial dominions in Italy. Robert and Roger of Hauteville afterwards conquered Sicily on their own account, not as mercenaries; for having ſubſtantially ſettled their power on the continent, they turned their arms againſt this iſland in obedience to the dictates of zeal and ambition. After ten years ſtruggle, the Saracens yielded up the rich prize, and Robert ceded it to his brother Roger, who aſſumed the title of Great Earl of Sicily, ruled the ſtate with wiſdom, and ranks deſervedly among the greateſt characters in hiſtory. He raiſed himſelf from the humble ſtation of a poor younger ſon of a private gentleman, to the exalted dignity of a powerful monarch, by the ſole force of his own genius and courage; he governed a nation of ſtrangers with vigour and juſtice, and tranſmitted his poſſeſſions undiſputed to his poſterity. Such an aſſemblage of great qualities is well intitled to our admiration.

He was ſucceeded by his ſon Simon, whoſe reign was ſhort, and made way for a ſecond ſon called Roger. In 1127 this prince joined to his Sicilian poſſeſſions the whole inheritance of Robert Guiſcard (ſee NAPLES, n° 23.), and aſſumed the regal ſtyle. The greateſt part of his reign was taken up in quelling revolts in Italy, but Sicily enjoyed profound peace. In 1154 his ſon William aſcended the throne, and paſſed his life in war and confuſion. William II. ſucceeded his father, and died without iſſue. Tancred, though baſely born, was elected his ſucceſſor, and after him his ſon William III. who was vanquiſhed by Henry of Swabia. During the troubles that agitated the reign of his ſon the emperor Frederic, peace appears to have been the lot of Sicily. A ſhort lived ſedition, and a revolt of the Saracens, are the only commotions of which we read. For greater ſecurity, the Saracens were removed to Puglia 400 years after the conqueſt of Sicily by their anceſtors. Under Conrad and Manfred Sicily remained quiet; and from that time the hiſtory of Sicily is related under the article NAPLES, n° 26, &c.

Sicily.

14 Under the dominion of different monarchs.

15 Is at length conquered by the Spaniards.

At the death of Charles II. of Spain, his ſpoils became an object of furious contention; and at the peace of Utrecht, Sicily was ceded to Victor duke of Savoy, who, not many years after, was forced by the emperor Charles VI. to relinquiſh that fine iſland, and take Sardinia as an equivalent. But as the Spaniards had no concern in theſe bargains, they made a ſudden attempt to recover Sicily, in which they failed through the vigilance of the Engliſh admiral Byng. He deſtroyed their fleet in 1718, and compelled them to drop their ſcheme for a time. In 1734 the Spaniſh court reſumed their deſign with ſucceſs. The infant Don Carlos drove the Germans out, and was crowned king of the two Sicilies at Palermo. When he paſſed into Spain to take poſſeſſion of that crown, he transferred the Sicilian diadem to his ſon Ferdinand III. of Sicily and IV. of Naples, and it has ever ſince remained in the poſſeſſion of the ſame family.

16 Account of the Straits of Meſſina.

Sicily is ſeparated, as we have already obſerved, from Italy by a narrow ſtrait called the *Faro of Meſſina*. This ſtrait is ſtill remarkable for the rapidity of its currents and the irregular ebbing and flowing of the ſea, which ſometimes ruſhes in with ſuch violence as to endanger ſhips riding at anchor. Anciently it was much more remarkable for Scylla and Charybdis, the one a rock, and the other a whirlpool, between which it was very dangerous to ſteer, and concerning which ſo many fables have been related by the ancients. Scylla is a rock on the Italian ſide, oppoſite to Cape Pylores, which runs out into the ſea on the Sicilian ſide. Mr Brydone informs us, that the navigation of the ſtraits is not even yet performed without danger. He informs us, that the noiſe of the current which ſets through the ſtraits may be heard for ſeveral miles, like the roaring of ſome large impetuous river confined between narrow banks. In many places the water roſe into whirlpools and eddies, which are dangerous to ſhipping. The current ſet exactly for the rock of Scylla, and would certainly have carried any thing thrown into it againſt that point. Our author, however, is by no means of opinion that the ſtrait is ſo dangerous as the ancients have repreſented it; though he thinks that the ſtrait is now probably much wider than formerly, which may have diminiſhed the danger. See SCYLLA. There are many ſmall rocks, which

Sicily. which ſhow their heads near the baſe of the large ones. Theſe are probably the dogs deſcribed by the ancient poets as howling round Scylla. The rock is near 200 feet high, and has a kind of caſtle or fort built on its ſummit with a town called *Scylla* or *Sciglio*, containing 300 or 400 inhabitants on its ſouth ſide, which gives the title of prince to a Calabreſe family.

Charybdis is now ſo much diminiſhed, that it ſeems almoſt reduced to nothing in compariſon of what it was, though even yet it is not to be paſſed without danger. See CHARYBDIS.

In the ſtraits, Mr Brydone informs us, a moſt ſurpriſing phenomenon is to be obſerved. In the heat of ſummer, after the ſea and air have been much agitated, there appears in the heavens over the ſtraits a great variety of ſingular forms, ſome at reſt and others moving with great velocity. Theſe forms, in proportion as the light increaſes, ſeem to become more aerial, till at laſt, ſome time before ſun-riſe, they totally diſappear. The Sicilians repreſent this as the moſt beautiful ſight in nature. Leonti, one of their beſt and lateſt writers, ſays, that the heavens appear crowded with a variety of objects, ſuch as palaces, woods, gardens, &c. beſides the figures of men and other animals that appear in motion among them. Some treatiſes have been written concerning this phenomenon; but nothing ſatisfactory has been delivered concerning its cauſe.

17 Climate and produce. Though Sicily lies in a warm climate, the air is healthful, being refreſhed with ſea-breezes on every ſide. It has at all times been remarkably fertile; but the era of its greateſt proſperity was from the ſiege of Syracuſe by the Athenians to the Carthaginian conqueſts. Then and long after it ſupplied with grain in years of ſcarcity all the countries upon the Mediterranean except Egypt and the coaſts of Aſia, and Rome and Carthage continually. Even now, under all the impediments of ſuperſtition and bad government, its productions are, in quantity and quality, the beſt in Europe. Of the vegetable are grain, wines, oil, fruits, tobacco, mulberry trees for the ſilkworm, cotton, medicinal roots, and ſugar canes. The laſt of theſe flouriſh near Avola and Merilli. They are of an inferior quality to thoſe of the Weſt Indies, but their ſugar is ſweeter than any other. The animal production is ſimilar to that of Italy, but the horned cattle are a ſmaller breed. The coaſts abound with fiſh, particularly with tunney and anchovies; the export of which forms a very lucrative branch of commerce. There are mines of ſilver, copper, and lead, but none are worked. Near Palma are beds of the beſt ſulphur: at the mouth of the river Giaretta is found a yellow amber, preferable to that of the Baltic; and in every part of the iſland quarries of marbles, that have furniſhed materials for all the noble edifices of Sicily. The moſt beautiful are in the neighbourhood of Palermo, particularly the yellow, and thoſe that reſemble the verde antique, porphyry, and lapis lazuli. The population of the iſland amounts to 1,300,000 ſouls; not as much again as the ſingle city of Syracuſe formerly contained.

Watkin's Travels through Switzerland, Italy, Sicily, &c.

18 Rivers and mountains. Here are ſeveral rivers and good ſprings; but few of the rivers are navigable, having but a ſhort courſe, and deſcending precipitately from the mountains. The chief are the Cantera, the Jarretta, and the Salſo; of which, the two former run from weſt to eaſt, and the third from north to ſouth.

Of the mountains in this iſland the moſt noted is Mount Etna, now called *Monte Gibello*, or *Mongibello*, a volcano whoſe eruptions have often proved fatal to the neighbouring country. See ETNA. Sicily.

19 Conſtitution and government. Were the Sicilians a cultivated people, among whom thoſe arts were encouraged which not only promote the wealth and comfort of a nation, but alſo exerciſe the nobler faculties and extend the views of mankind, the circumſtances of their government are ſuch, that it might gradually be improved into a free conſtitution: but to this, the ignorance, ſuperſtition, and poverty, of the people ſeem to be invincible obſtacles. The monarchical power in Sicily is far from being abſolute; and the parliament claims a ſhare of public authority independently of the will of the king, deduced from a compact made between Roger and the Norman barons after the expulſion of the Saracens, This claim is denied by the king, who wiſhes the nobles to conſider their privileges as derived ſolely from his favour. Hence the government is in a ſituation which greatly reſembles that of our own and the other kingdoms of Europe in the feudal times; there are continual jealouſies and oppoſitions between the king and the barons, of which an enlightened people might eaſily take advantage, and obtain that ſhare in the conſtitution which might ſecure them from future oppreſſion. In theſe diſputes, the king has the advantage at leaſt of power if not of right; and ſeveral works, in which the claims of the Sicilian barons have been aſſerted, were publicly burned a few years ago. *Munter's Memoirs relative to Naples and Sicily.*

As the ſovereign holds his court at Naples, Sicily is governed by a viceroy, who is appointed only for three years, though at the end of that term his commiſſion is ſometimes renewed. He lives in great ſtate, and, as the repreſentative of the king, his power is very conſiderable. He preſides in all the courts and departments of government, and is commander in chief of all the forces: he calls or diſſolves the parliament when he pleaſes; and by him all orders, laws, and ſentences, muſt be ſigned: but his office is far from being deſirable, as it generally renders him the object either of the jealouſy of the court of Naples, or of the hatred of the Sicilians.

The parliament conſiſts of the nobles, the biſhops, and abbots, and the repreſentatives of 43 cities, which are immediately ſubject to the crown. Thoſe cities which are ſubject to any of the nobles ſend no members to the parliament; in theſe the king has not much authority, and derives little advantage from them. According to the laws, the parliament ought to be aſſembled at the end of every three years: but the government pays little attention to this rule. The common people are in general very much attached to the nobles, and are inclined to take their part in all their differences with the court: but the magiſtrates and principal inhabitants of the cities which belong to theſe feudal lords, wiſh to get rid of their authority, and imagine that they ſhould be leſs oppreſſed, if immediately ſubject to the king: theſe inclinations are not diſagreeable to the court, and are encouraged by moſt of the lawyers, who are of great ſervice to government in conteſting the privileges of the nobles. Many of theſe privileges are now abridged; and the power of the barons, with reſpect to the adminiſtration of juſtice in their domains, was very properly limited by the viceroy Caraccioli,

Sicily.

raccioli, in the year 1785. The government of this nobleman was very beneficial to Sicily, as he, in a great measure, cleared the island of the banditti that used to infest it, and made several excellent regulations for the establishment of social order and personal security. He deserves the thanks of every well-wisher to mankind for having abolished the court of inquisition, which had been established in this country by Ferdinand the Catholic, and made dependent on the authority of the grand inquisitor of Spain. Its last *auto da fe* was held in the year 1724, when two persons were burned. At length Charles III. rendered it independent of the Spanish inquisitor, and abridged its power, by forbidding it to make use of the torture, and to inflict public punishments. The Marchese Squillace, and his successor the Marchese Tanucci, were both enemies to the hierarchy; and, during their viceroyalties, took care to appoint sensible and liberal men to the office of inquisitor: the last of whom was Ventimiglia, a man of a most humane and amiable character, who heartily wished for the abolition of this diabolical court, and readily contributed toward it. While he held the office of inquisitor, he always endeavoured to procure the acquittal of the accused; and when he could succeed no other way, would pretend some informality in the trial. The total annihilation of this instrument of the worst of tyranny was reserved for Caraccioli. A priest being accused to the inquisition, was dragged out of his house and thrown into the dungeon. He was condemned; but, on account of informality, and a violation of justice in the trial, he appealed to the viceroy, who appointed a committee of jurists to examine the process. The inquisitor refused to acknowledge the authority of this commission; pretending that to expose the secrets of the holy office, and to submit its decisions to the examination of lay judges, would be so inconsistent with his duty, that he would see the inquisition abolished rather than consent to it. Caraccioli took him at his word, and procured a royal mandate by which the holy office was at once annihilated. He assembled all the nobility, judges, and bishops, on the 27th of March 1782, in the palace of the inquisition, and commanded the king's order to be read; after which he took possession of the archives, and caused all the prisons to be set open: in these were at that time only two prisoners, who had been condemned to perpetual confinement for witchcraft. The papers relating to the finances were preserved; but all the rest were publicly burned. The possessions of the holy office were assigned to the use of churches and charitable institutions: but the officers then belonging to it retained their salaries during their lives. The palace itself is converted into a customhouse, and the place where heretics were formerly roasted alive for the honour of the Catholic faith, is now changed into a public garden. The cognizance of offences against orthodoxy is committed to the bishops: but they cannot cite any one to appear before them without permission from the viceroy; neither can they confine any person to a solitary prison, nor deny him the privilege of writing to his friends, and conversing freely with his advocate. The nobility are so numerous in this island, that Labat says it is paved with noblemen. The general assembly of parliament is composed of 66 archbishops, bishops, abbots, and priors, which form the Bracchio ecclesiastico. Fifty-eight princes, 27 dukes, 37 marquisses, 27 counts, 1 viscount, and 79 barons, form the militaire; and the demaniale consists of 43 representatives of free towns. Out of each bracchio four deputies are chosen to conduct public business. But the viceroy, the prince of Butera, and the prætor of Palermo, are always the three first. *N. B.* There are many titled persons that have no seat in the assembly, viz. 62 princes, 55 dukes, 87 marquisses, 1 count, and 282 other feudatories. There are three archbishoprics and seven bishoprics; and the island, ever since it was conquered by the Saracens, has been divided into three parts or valleys; namely, the *Val di Demone*, *Val di Noto*, and *Val di Mazzara*.

20 Inquisition

21 Abolished by Caraccioli.

Sicinnius || Sida.

SICINNIUS (Dentatus), a tribune of the people, lived a little after the expulsion of the kings from Rome. He was in 120 battles and skirmishes, besides single combats, in all of which he came off conqueror. He served under nine generals, all of whom triumphed by his means. In these battles he received 45 wounds in the fore-part of his body, and not one in his back. The senate made him great presents, and he was honoured with the name of the Roman Achilles.

SICYOS, in botany: A genus of plants belonging to the class of monœcia, and to the order of syngenesia, and in the natural system arranged under the 34th order, *Cucurbitaceæ*. The male flowers have their calyx quinquedentated, their corolla quinquepartite, and there are three filaments. The female flowers have their calyx and corolla similar; but their style is trifid, and their drupa monospermous. There are three species, the *angulata*, *laciniata*, and *garcini*, which are all foreign plants.

SIDA, *Yellow* or *Indian Mallow*, in botany: A genus of plants belonging to the class of monadelphia, and to the order of polyandria; and in the natural system ranging under the 37th order, *Columniferæ*. The calyx is simple and angulated; the style is divided into many parts; there are several capsules, each containing one seed. There are 27 species. 1. The Spinosa; 2. Angustifolia; 3. Alba; 4. Rhombifolia; 5. Alnifolia; 6. Ciliaris; 7. Retusa; 8. Triquetra; 9. Jamaicensis; 10. Carpinifolia; 11. Viscosa; 12. Cordifolia; 13. Umbellatæ; 14. Paniculata; 15. Atrosanguinea; 16. Periplocifolia; 17. Urens; 18. Arborea; 19. Occidentalis; 20. Americana; 21. Abutilon; 22. Mauritiana; 23. Asiatica; 24. Indica; 25. Crispa; 26. Cristata; 27. Ternata. The first 18 species have 15 capsules; the rest are multicapsular. They are all natives of warm climates; and most of them are found in the East or West Indies.

The Chinese make cords of the sida abutilon. This plant loves water, and may be advantageously planted in marshes and ditches, where nothing else will grow. From experiments made by the Abbé Cavanilles, a Spaniard, which are inserted in the *Mem. de l'Acad. Royale*, it appears that the plants succeed best when sown in May, and they arrive at perfection in three months and a half. The maceration of the smaller stalks is finished in about 15 days; of the larger in a month. The strength and goodness of the thread appeared to be in proportion to the perfection of the vegetation, and to the distance the plant was kept at from other plants. The fibres lie in strata, of which there are sometimes six: they are not quite straight, but preserve an undulating direction, so as to form a network in their natu-

Siddee ‖ Sideritis.

ral poſitions. Their ſmell reſembles that of hemp; the fibres are whiter, but more dry and harſh than thoſe of hemp. The harſhneſs is owing to a greeniſh gluten which connects the fibres; and the white colour muſt always be obtained at the expence of having this kind of thread leſs ſupple; when of its natural hue, it is very ſoft and flexible. This deſcription belongs chiefly to the ſida; but it will alſo apply to the malva criſpa, Peruviana, and Mauritiana. The malva criſpa gave, however, the greateſt quantity of fibres, and its gluten was moſt copious. The fibres of the ſida abutilon, and the malva criſpa, are the longeſt and the ſtrongeſt; thoſe of the Peruviana and Mauritiana are the ſhorteſt and weakeſt. The fibres of thoſe plants which had loſt their leaves are leſs ſtrong, though of equal length with thoſe which had preſerved them.

SIDDEE, or SEDEE: an Arabic title, by which the Abyſſinians or Habaſhys are always diſtinguiſhed in the courts of Hindoſtan; where, being in great repute for firmneſs and fidelity, they are generally employed as commanders of forts or in poſts of great truſt.

SIDEREAL YEAR. See *ASTRONOMY-Index*.

SIDERIA, in natural hiſtory, the name of a genus of cryſtals, uſed to expreſs thoſe altered in their figure by particles of iron. Theſe are of a rhomboidal figure, and compoſed only of ſix planes. Of this genus there are four known ſpecies. 1. A colourleſs, pellucid, and thin one; found in conſiderable quantities among the iron ores of the foreſt of Dean in Glouceſterſhire, and in ſeveral other places. 2. A dull, thick, and brown one; not uncommon in the ſame places with the former. And, 3. A black and very gloſſy kind, a foſſil of great beauty; found in the ſame place with the others, as alſo in Leiceſterſhire and Suſſex.

SIDERITE, a ſubſtance diſcovered by Mr Meyer, and by him ſuppoſed to be a new metal; but Meſſrs Bergman and Kirwan have diſcovered that it is nothing elſe than a natural combination of the phoſphoric acid with iron. Mr Klaproth of Berlin alſo came to the ſame concluſion, without any communication with Mr Meyer. It is extremely difficult to ſeparate this acid from the metal; however, he found the artificial compound of phoſphoric acid and iron to agree in its properties with the calx ſideri alba obtained by Bergman and Meyer from the cold-ſhort iron extracted from the ſwampy or marſhy ores. The diſcovery of this ſubſtance, however, may be accounted an important affair in chemiſtry, as we are thus furniſhed with an immenſe quantity of phoſphoric acid, which might be applied to uſeful purpoſes if it could be ſeparated from the metal.

SIDERITIS, IRONWORT, in botany: A genus of plants belonging to the claſs of didynamia, and to the order of gymnoſpermia; and in the natural ſyſtem ranging under the 42d order, *Verticillatæ*. The ſtamina are within the tube of the corolla. There are two ſtigmas, one of which is cylindrical and concave; the other, which is lower, is membranous, ſhorter, and ſheathing the other. The ſpecies are 13. 1. The Canarienſis, or Canary ironwort, which is a native of Madeira and the Canary iſlands; 2. The Candicans, which is alſo a native of Madeira; 3. The Syriaca, a native of the Levant; 4. The Perfoliata, a native of the Levant; 5. The Montana, a native of Italy and Auſtria; 6. The Elegans; 7. The Romana, a native of Italy; 8. The Incana, a native of Spain; 9. The Hyſſopifolia, a native of Italy and the Pyrenees; 10. The Scordioides, a native of the ſouth of France; 11. The Hirſuta, which is indigenous in the ſouth of Europe; 12. The Ciliata; 13. The Lanata.

Sideroxylon, Sidney.

SIDEROXYLON, IRON-WOOD, in botany: A genus of plants belonging to the claſs of pentandria, and to the order of monogynia; and in the natural ſyſtem ranging under the 43d order, *Dumoſæ*. The corolla is cut into 10 parts, the laciniæ or ſegments being incurvated alternately; the ſtigma is ſimple; the berry contains five ſeeds. There are ten ſpecies: 1. Mite; 2. Inerme, ſmooth iron-wood; 3. Melanophleum, laurel-leaved iron-wood; 4. Fœtidiſſimum; 5. Cymoſum—both natives of the Cape of Good Hope; 6. Sericeum, ſilky iron-wood, a native of New South Wales; 7. Tenax, ſilvery-leaved iron-wood, a native of Carolina; 8. Lycioides, willow-leaved iron-wood, a native of North America; 9. Spinoſum, thorny iron-wood or argan, a native of Morocco; 10. Decandrum.

The wood of theſe trees being very cloſe and ſolid, has given occaſion for this name to be applied to them, it being ſo heavy as to ſink in water. As they are natives of warm countries, they cannot be preſerved in this country unleſs they are placed, the two former in a warm ſtove, the others in a green-houſe. They are propagated by ſeeds, when theſe can be procured from abroad.

SIDNEY (Sir Philip), was born, as is ſuppoſed, at Penſhurſt in Kent in the year 1554: His father was Sir Henry Sidney, an Iriſh gentleman, and his mother Mary the eldeſt daughter of John Dudley duke of Northumberland. He was ſent when very young to Chriſt-church college at Oxford, but left the univerſity at 17 to ſet out on his travels. After viſiting France, Germany, Hungary, and Italy, he returned to England in 1575, and was next year ſent by Queen Elizabeth as her ambaſſador to Randolph emperor of Germany. On his return he viſited Don John of Auſtria, governor of the Netherlands, by whom he was received with great reſpect. In 1579, when Queen Elizabeth ſeemed on the point of concluding her long projected marriage with the duke of Anjou, Sir Philip wrote her a letter, in which he diſſuaded her from the match with unuſual elegance of expreſſion, as well as force of reaſoning. About this time a quarrel with the earl of Oxford occaſioned his withdrawing from court; during which retirement he is ſuppoſed to have written his celebrated romance called *Arcadia*.

In 1585, after the queen's treaty with the United States, he was made governor of Fluſhing and maſter of the horſe. Here he diſtinguiſhed himſelf ſo much both by his courage and conduct, that his reputation roſe to the higheſt pitch. He was named, it is pretended, by the republic of Poland as one of the competitors for that crown, and might even have been elected had it not been for the interference of the queen. But his illuſtrious career was ſoon terminated; for in 1586 he was wounded at the battle of Zutphen, and carried to Arnheim, where he ſoon after died. His body was brought to London, and buried in St Paul's cathedral. He is deſcribed by the writers of that age as the moſt perfect model of an accompliſhed gentleman that could be formed even by the wanton imagination of poetry or fiction. Virtuous conduct, polite converſation, heroic valour,

Sidney. lour, and elegant erudition, all concurred to render him the ornament and delight of the Engliſh court: and as the credit which he enjoyed with the queen and the earl of Leiceſter was wholly employed in the encouragement of genius and literature, his praiſes have been tranſmitted with advantage to poſterity. No perſon was ſo low as not to become an object of his humanity. After the battle of Zutphen, while he was lying on the field mangled with wounds, a bottle of water was brought him to relieve his thirſt; but obſerving a ſoldier near him in a like miſerable condition, he ſaid, *This man's neceſſity is ſtill greater than mine;* and reſigned to him the bottle of water. Beſides his *Arcadia*, he wrote ſeveral ſmaller pieces both in proſe and verſe, which have been publiſhed.

SIDNEY (Algernon), was the ſecond ſon of Robert earl of Leiceſter, and of Dorothy eldeſt daughter of the earl of Northumberland. He was born about the year 1617. During the civil wars he took part againſt the king, and diſtinguiſhed himſelf as a colonel in the army of the parliament. He was afterwards appointed one of king Charles's judges, but declined appearing in that court. During the uſurpation of Cromwel, Sidney, who was a violent republican, retired to the country, and ſpent his time in writing thoſe diſcourſes on government which have been ſo deſervedly celebrated. After the death of the Protector, he again took part in the public tranſactions of his country, and was abroad on an embaſſy to Denmark when king Charles was reſtored. Upon this he retired to Hamburgh, and afterwards to Francfort, where he reſided till 1677, when he returned to England and obtained from the king a pardon. It has been affirmed, but the ſtory deſerves no credit, that during his reſidence abroad king Charles hired ruffians to aſſaſſinate him. After his return he made repeated attempts to procure a ſeat in parliament, but all of them proved unſucceſsful. After the intention of the commons to ſeclude the duke of York from the throne had been defeated by the ſudden diſſolution of parliament, Sidney joined with eagerneſs the councils of Ruſſel, Eſſex, and Monmouth, who had reſolved to oppoſe the duke's ſucceſſion by force of arms. Frequent meetings were held at London; while, at the ſame time, a ſet of ſubordinate conſpirators, who were not, however, admitted into their confidence, met and embraced the moſt deſperate reſolutions. Keiling, one of theſe men, diſcovered the whole conſpiracy; and Algernon Sidney, together with his noble aſſociates, was immediately thrown into priſon, and no art was left unattempted in order to involve them in the guilt of the meaner conſpirators.

Howard, an abandoned nobleman, without a ſingle ſpark of virtue or honour, was the only witneſs againſt Sidney; but as the law required two, his diſcourſes on government, found unpubliſhed in his cloſet, were conſtrued into treaſon, and declared equivalent to another witneſs. It was in vain for Sidney to plead that papers were no legal evidence; that it could not be proved they were written by him; and that if they were, they contained nothing treaſonable. The defence was over-ruled; he was declared guilty, condemned, and executed! His attainder was reverſed in the firſt year of king William.

He was a man of extraordinary courage; ſteady even to obſtinacy; of a ſincere but rough and boiſterous temper. Though he profeſſed his belief in the Chriſtian religion, he was an enemy to an eſtabliſhed church, and even, according to Burnet, to every kind of public worſhip. In his principles he was a zealous republican: government was always his favourite ſtudy; and his eſſays on that ſubject are a proof of the progreſs which he made. Sidon, Sidus.

SIDON (anc. geog.), a city of Phœnicia in Aſia, famous in Scripture for its riches, ariſing from the extenſive commerce carried on by its inhabitants. Heavy judgments were denounced againſt the Sidonians on account of their wickedneſs, which were accompliſhed in the time of Ochus king of Perſia: for that monarch having come againſt them with an army on account of their rebellion, the city was betrayed by its king; upon which the wretched inhabitants were ſeized with deſpair; they ſet fire to their houſes, and 40,000, with their wives and children, periſhed in the flames.

This city is now called *Saide*, and, according to Mr Bruce's account, not only its harbour is filled up with ſand, but the pavement of the ancient city ſtood 7½ feet lower than the ground on which the preſent city ſtands. Volney deſcribes it as an ill-built dirty city. Its length along the ſea-ſhore is about 600 paces, and its breadth 150. At the north-weſt ſide of the town is the caſtle, which is built in the ſea itſelf, 80 paces from the main land, to which it is joined by arches. To the weſt of this caſtle is a ſhoal 15 feet high above the ſea, and about 200 paces long. The ſpace between this ſhoal and the caſtle forms the road, but veſſels are not ſafe there in bad weather. The ſhoal, which extends along the town, has a baſon incloſed by a decayed pier. This was the ancient port; but it is ſo choaked up by ſand, that boats alone can enter its mouth near the caſtle. Fakr-el-din, emir of the Druſes, deſtroyed all theſe little ports from Bairout to Acre, by ſinking boats and ſtones to prevent the Turkiſh ſhips from entering them. The baſon of Saide, if it were emptied, might contain 20 or 25 ſmall veſſels. On the ſide of the ſea, the town is abſolutely without any wall; and that which encloſes it on the land ſide is no better than a priſon-wall. The whole artillery does not exceed ſix cannons, and theſe are without carriages and gunners. The garriſon ſcarcely amounts to 100 men. The water comes from the river Aoula, through open canals, from which it is fetched by the women. Theſe canals ſerve alſo to water the orchards of mulberry and lemon trees.

Saide is a conſiderable trading town, and is the chief emporium of Damaſcus and the interior country. The French, who are the only Europeans to be found there, have a conſul, and five or ſix commercial houſes. Their exports conſiſt in ſilks, and particularly in raw and ſpun cottons. The manufacture of this cotton is the principal art of the inhabitants, the number of whom may be eſtimated at about 5000. It is 45 miles weſt from Damaſcus. E. Long. 36. 5. N. Lat. 37.

SIDUS GEORGIUM, in aſtronomy, a new primary planet, diſcovered by Dr Herſchell in the year 1781. By moſt foreign, and even by ſome Britiſh philoſophers, it is known by the name of *Herſchell*, an honour which is due to the diſcoverer. As the other planets are diſtinguiſhed by marks or characters, the planet Herſchell is diſtinguiſhed by an H, the initial letter of the diſcoverer's name, and a croſs to ſhow that it is a Chriſtian planet. From many calculations of our beſt aſtrono-

Siege || Sierra.

mers and mathematicians, says Dr Herschell, I have collected the following particulars, as most to be depended upon.

Place of the node - -	2s 11d 49′ 30″	
Inclination of the orbit -	43′ 35′	
Place of the perihelion -	172d 13′ 17″	
Time of the perihelion passage	Sep. 7. 1799	
Eccentricity of the orbit	,82034	
Half the greater axis	19,07904	
Revolution -	83,3364	siderial years.

From my own observations on this planet's apparent diameter, which I have found cannot well be less than 4″, nor indeed much greater, we infer, that its real diameter is to that of the earth as 4,454 to 1; and hence it appears to be of very considerable bulk, and, except Saturn and Jupiter, by far the largest of the remaining planets. Its light is of a bluish-white colour, and in brilliancy between that of the Moon and of Venus. With a telescope which magnifies about 300 times, it appears to have a very well defined visible disk; but with instruments of a small power, it can hardly be distinguished from a fixed star of between the sixth and seventh magnitude. In a very fine clear night, when the moon is absent, it may also be seen by the naked eye.

SIEGE, in the art of war, is to surround a fortified place with an army, and approach it by passages made in the ground, so as to be covered against the fire of the place.

SIEGEN, a town of Germany in Wetteravia, with a castle and the title of a principality, which it gives to a branch of the house of Nassau. It is seated on a river of the same name, in E. Long. 8. 5. N. Lat. 50. 53.

SIENNA, a large, ancient, and celebrated city of Tuscany in Italy; capital of the Siennese, with an archbishop's see, a famous university, and a citadel. It is about four miles in circumference, and surrounded with an old wall. The metropolitan church is much esteemed by travellers; and though it is a Gothic structure, the architecture is admirable. It is built with black and white marble, and the pavement is of Mosaic work. The town is adorned with a great number of palaces, fountains, and superb churches, as also a magnificent hospital. The great area is round, and the houses about it are of the same height, supported by piazzas, under which people may walk in hot or rainy weather; in the middle is a bason, which can be filled with water at any time, to represent a sea-fight with small vessels. The Italian language is taught here with such purity, that a great many foreigners frequent it on that account. It is seated on three eminences, in a fertile soil, in E. Long. 11. 11. N. Lat. 43. 10.

SIENNESE, a duchy in Italy; bounded on the north by the Florentino, on the south by the Mediterranean sea and the duchy of Castro, on the east by the Perugino and Orvietano, and on the west by the Florentino and the Tuscan sea; being about 55 miles in length, and as much in breadth. The soil is pretty fertile, especially in mulberry trees, which feed a great number of silk-worms; and there are several mineral springs. Sienna is the capital town.

SIERRA LEONA, a large country on the west coast of Africa, which some extend from the Grain Coast on the south-east to Cape Verga or Vega on the north-west, *i. e.* between 7° and 10° N. Lat. Others, however, confine the country between Cape Verga and Cape Tagrin. There runs through it a great river of the same name, of which the source is unknown, but the mouth is in longitude 12. 30. west, lat. 8. 5. north, and is nine miles wide. The climate and soil of this tract of country appear to be, on both sides of the river, among the best in Africa, or at least the most favourable to European constitutions. The heat is much the same as that of the West Indies; but on the higher grounds there is a cool sea breeze, and in the mountainous parts the air is very temperate. According to Lieutenant Matthew, "Sierra Leona, if properly cleared and cultivated, would be equal in salubrity and superior in produce to any of the islands in the West Indies;" and others have affirmed, that "the air is better for a man's health than in many places of Europe." These advantages of climate induced the English to establish a factory at Sierra Leona; but they chose not the most healthful situation. For the benefit of a spring of good water they fixed their residence in a low valley, which is often overspread with mists and noisome vapours, while the air is clear and serene on the summits of the hills, to which water from the well might be easily carried. Sierra.

The animal productions of this country are lions, from which it has its name; leopards, hyænas, musk cats, and many kinds of weasels; the japanzee or chimpanzee, a species of simia, which has a still more striking resemblance to the human figure than even the ouran outang; porcupines, wild hogs, squirrels, and antelopes. Besides these, which are natives of the country, oxen thrive in it, and even grow fat; asses too are employed in labour, and do not suffer by the climate; but sheep suffer much from the heat, change their wool into hair, grow lean and increase very little; while the hardy goat is here as prolific and large as in any other country. Of the birds which frequent the woods of Sierra Leona we can give no perfect account. A species of crane is mentioned as easily tamed; common poultry multiply fast; ducks thrive well, but geese and turkeys seem not to agree with the climate. Turtles of all kinds are very common, and sometimes of a large size. Crocodiles or alligators of a non-descript species have been found ten or twelve feet in length, and lizards of six different species. Snakes, which are almost innumerable, haunt the houses in the night in search of poultry; and one was observed which measured 18 feet, but was happily found not to be venomous. Fishes are in great variety both in the sea and in the rivers. Besides the whale, the shark, stinging ray, and porpoise, there are eels, horse-mackarel, tarpoons, cavillos, mullets, snappers, yellow-tails, old-maids, ten-pounders, and some other fishes; all of which, except the eels and ten-pounders, are esteemed fine eating. Oysters are found in great abundance, and another shell-fish, which the natives eat. Among the zoophites, none is more worthy of notice than the common sponge, which covers all the sandy beaches of the river, particularly on the Bullom shore, and would fetch a high price in Great Britain.

Of the numerous vegetable productions of Sierra Leona, our limits will permit us only to mention the following. Rice, which is the plant chiefly cultivated, as the natives subsist almost entirely upon it, grows both in

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in the high and low grounds. It proſpers indeed beſt in ſwamps, though the grain is better in a drier ſoil. Next to rice the caſſada conſtitutes the chief food of the inhabitants, and is cultivated with great care. The country likewiſe produces yams, various kinds of potatoes, eddoes, or the *arum eſculentum*. Oil-palm, plantains, and bananas; papaw, guava, oranges and limes; pompions, melons, and cucumbers; pine-apples, pigeon-peas, which dreſſed like Engliſh peas are a good pulſe; maize or Indian corn; millet, cocoa-nut trees; ockra; the tallow-tree; a great variety of tamarinds; different kinds of fig-trees and plums; a kind of fruit reſembling grapes, but more acid and acrid; cherries reſembling a fine nectarine in taſte; a ſpecies of the bread fruit-tree; the cream fruit, ſo called becauſe when wounded it yields a fine white juice reſembling ſugar or the beſt milk, of which the natives are very fond; the malaguetta pepper, or grains of paradiſe; a new ſpecies of nutmeg, but whether ſo good as the common ſort has not yet been aſcertained; a new ſpecies of the Peruvian bark, which it is hoped will prove as uſeful as the other; and cola, a fruit highly eſteemed by the natives for the ſame virtues with that bark; the ricinus, caſſia, dye-ſtuffs, and gums, of great value; cotton, tobacco, and ſugar-canes, which, it is thought, would thrive exceedingly well under proper cultivation.

Conſidering the ardour of the maritime nations of Europe for ſettling colonies in diſtant regions of the globe, it is ſomewhat ſurpriſing that a climate ſo temperate and a ſoil ſo productive as that of Sierra Leona did not long ago attract their notice. But it was left to be colonized for a better purpoſe than that which firſt drew the natives of Europe to the Weſt Indies and the American continent. Being thinly inhabited, Sierra Leona appeared to ſome benevolent gentlemen in England a place where, without incommoding the natives, a ſufficient quantity of ground might be bought on which to ſettle a great number of free negroes, who in 1786 ſwarmed in London in idleneſs and want. About 400 of theſe wretches, together with 60 whites, moſtly women of bad character and in ill health, were accordingly ſent out, at the charge of government, to Sierra Leona. Neceſſity, it was hoped, would make them induſtrious and orderly; and Captain Thomſon of the navy, who conducted them, obtained, for their uſe, a grant of land to his majeſty from king Tom, the neighbouring chief, and afterwards from Naimbanna, the king of the country. The colony, however, ſoon went to ruin; but the land which they occupied being about 20 miles ſquare, his majeſty was enabled to grant by act of parliament to another colony founded on better principles and for a ſtill nobler purpoſe.

The moſt intelligent members of that ſociety, which has laboured ſo ſtrenuouſly to procure an abolition of the ſlave-trade, juſtly concluding that the natives of Guinea would reap very little benefit from the attainment of their object, unleſs they ſhould be taught the principles of religion and the arts of civil life, which alone can render them really free, conceived the plan of a colony at Sierra Leona to be ſettled for the truly generous purpoſe of civilizing the Africans by maintaining with them a friendly intercourſe, and a commerce in every thing but men. This plan could not be carried into effect but at a very great expence. Subſcriptions were therefore opened upon rational and equitable terms, and a ſum deemed ſufficient was ſpeedily raiſed. An act of parliament was paſſed in favour of the ſubſcribers, by which they were incorporated by the denomination of the *Sierra Leona Company*; and in purſuance of that act they held their firſt meeting at London on the 19th of October 1791, when the following gentlemen wore choſen directors for that year. Sierra.

"Henry Thornton, Eſq; M. P. chairman—Philip Sanſom, Eſq; deputy chairman—Sir Charles Middleton, Bart.—Sir George Young, Knt.—William Wilberforce, Eſq; M. P.—Rev. Thomas Clarkſon, A. M.—Joſeph Hardcaſtle, Eſq;—John Kingſton, Eſq;—Samuel Parker, Eſq;—Granville Sharp, Eſq;—William Sandford, Eſq;—Vickeris Taylor, Eſq;—George Wolf, Eſq."

The directors having ſtated the natural advantages of Sierra Leona, and its preſent miſerable condition, obſerved, that they had not merely to eſtabliſh a commercial factory, but that, to introduce civilization, cultivation, and a ſafe trade, the company muſt provide for the ſecurity of the perſons and property of the coloniſts. The directors therefore reſolved, that three or four veſſels ſhould ſail at once, with ſuch a number of people as would be able to protect and aſſiſt each other; with goods both for trade and for the ſupply of the colony. Accordingly ſeveral veſſels ſailed, having on board a council for the government of the colony and the management of the company's affairs; a number of artificers and other ſervants of the company; ſome ſoldiers, and a very few Engliſh ſettlers. The directors were laudably cautious in the choice of coloniſts. They admitted into the ſociety no white man of bad character, or who was not a declared enemy to the ſlave-trade; and as the chief object of their enterpriſe was the civilization of the natives, it was with great propriety that they choſe more than three-fourths of their ſettlers from the free negroes in Nova Scotia, who had borne arms for the Britiſh government during the American war. The ſuperintendant and council were particularly inſtructed to ſecure to all blacks and people of colour, at Sierra Leona, equal rights and equal treatment, in all reſpects, with whites. They were to be tried by jury, as well as others; and the council was deſired to allot to the blacks employments ſuited to their preſent abilities, and to afford them every opportunity of cultivating their talents. All practicable means of maintaining ſubordination were directed to be uſed; and the council was eſpecially inſtructed to promote religion and morals, by ſupporting public worſhip and the due obſervance of the Sabbath, and by the inſtruction of the people, and the education of children. But no perſon was to be prevented from performing or attending religious worſhip in whatever place, time, or manner, he might think fit, or from peaceably inculcating his own religious opinions. Orders were given in chooſing the ſcite of a town, to conſider health as the firſt object; and the firſt town was directed to be called *Free-Town*. Articles for building and cultivation were ſent out, beſides the cargoes for proſecuting the company's commerce; and ſchools for reading, writing, and accounts, were ordered to be ſet up for the purpoſe of inſtructing the children of ſuch natives as ſhould be willing to put them under the company's care.

The leading object of the company was to ſubſtitute, for that diſgraceful traffic which has too long ſubſiſted,

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Sierra. a fair commerce with Africa, and all the bleſſings which might be expected to attend it. Conſiderable advantages appeared hereby likely to reſult to Great Britain, not only from our obtaining ſeveral commodities cheaper, but alſo from opening a market for Britiſh manufactures, to the increaſing demands of which it is difficult to aſſign a limit. From this connection, Africa was likely to derive the ſtill more important benefits of religion, morality, and civilization. To accompliſh theſe purpoſes, it was neceſſary for the company to poſſeſs a tract of land, as a repoſitory for their goods, and which the Africans might cultivate in peace, ſecure from the ravages of the ſlave-trade. It had been aſcertained, beyond a doubt, that the climate and ſoil of Africa were admirably ſuited to the growth of ſugar, ſpices, coffee, cotton, indigo, rice, and every other ſpecies of tropical produce. The company propoſed to inſtruct the natives to raiſe theſe articles, and to ſet them the example, by a ſpirited cultivation, on its own account. Directions were given to the company's commercial agent to puſh forward a trade, in a mode preſcribed, in the preſent produce of Africa. Meaſures were taken for cultivating, on the company's account, the moſt profitable tropical produce; and in particular, a perſon of long experience in the Weſt Indies was ordered to begin a ſugar plantation. A mineralogiſt and botaniſt were likewiſe engaged to go out and explore the country for new articles of commerce.

Every thing being thus ſettled upon the moſt equitable and benevolent principles, the ſhips ſailed with the Britiſh coloniſts, to whom, in March 1792, were added 1131 blacks from Nova Scotia. The native chiefs being reconciled to the plan, and made to underſtand its beneficent tendency towards their people, the colony proceeded to build *Free-Town*, on a dry and rather elevated ſpot on the ſouth ſide of the river. It occupied between 70 and 80 acres, its length being about one-third of a mile, and its breadth nearly the ſame; and it contained near 400 houſes, each having one-twelfth of an acre annexed, on which a few vegetables were raiſed. There were nine ſtreets running from north-weſt to ſouth-eaſt, and three croſs ſtreets, all 80 feet wide, except one of 160 feet, in the middle of which were all the public buildings. Theſe conſiſted of a governor's houſe and offices; a large ſtore-houſe; a large hoſpital; ſix or eight other houſes, offices, and ſhops, occupied by the company's ſervants; and a church capable of containing 800 people. The coloniſts at firſt ſuffered much from the rainy ſeaſon, againſt which it was not in their power to provide ſufficient protection; but at the end of it they recovered in a great meaſure their health and ſpirits, and proceeded with alacrity to execute the various purpoſes of their ſettlement. To excite emulation in culture, the government gave premiums to thoſe coloniſts who raiſed the greateſt quantities of rice, yams, eddoes, cabbages, Indian corn, and cotton, reſpectively. To limit the exceſſes of the ſlave-trade, and gain the favour of the neighbouring chiefs, the directors inſtructed the governor and council to redeem any native from the neighbourhood, who ſhould be unjuſtly ſold either to or by a Britiſh ſubject. The ſervants of the company conducted themſelves with the utmoſt propriety, being ſober, moral, and exemplary; and from the labours of the clergymen were derived ſervices highly important in every point of view. Before the end of two years from the inſtitution of the colony, order and induſtry had begun to ſhow their effects in an increaſing proſperity. The woods had been cut down to the diſtance of about three Engliſh miles all round the town. By theſe means the climate had become healthier, and ſickneſs had diminiſhed. The fame of the colony had ſpread not only along the whole weſtern coaſt of Africa, but alſo to parts far diſtant from the coaſt; embaſſies had been received of the moſt friendly nature from kings and princes ſeveral hundred miles diſtant; and the native chiefs had begun to ſend their children to the colony, with full confidence, to be taught reading, writing, and accounts, and to be brought up in the Chriſtian religion. In a word, it was not without grounds that the directors looked forward to that joyful period when, by the influence of the company's meaſures, the continent of Africa ſhould be reſcued from her preſent ſtate of darkneſs and miſery, and exhibit a delightful ſcene of light and knowledge, of civilization and order, of peaceful induſtry and domeſtic comfort. On their beneficent exertions they hoped with confidence for the bleſſing of Providence; they were countenanced and ſupported by the Britiſh government; and upon the breaking out of the preſent war, the French Convention authoriſed one of their agents to write to the directors, requeſting a full account of the deſign of the inſtitution, and the names of the ſhips employed in their ſervice, and aſſuring them of the good wiſhes of the French government to ſo noble an undertaking. How completely that government fulfilled its promiſe is very generally known. Having vindicated the rights of man in Europe by the violation of every principle of truth and juſtice, they determined by the ſame means to give light and liberty to the Africans; and that they have fully carried their determination into effect will be ſeen by the following extract of a letter from Mr Afzelius, the company's botaniſt, dated Sierra Leona, 15th November 1794. "The French have been here and have ruined us. They arrived on the 28th of September laſt, early in the morning, with a fleet conſiſting of one large ſhip, two frigates, two armed brigs, and one cutter, together with two large armed merchant ſhips, taken by them at the Iſles de Loſs, an Engliſh ſlave factory to the north of our colony, and which they have alſo deſtroyed and burnt. So well had they concealed their nation, that we took them at firſt for Engliſh. They had Engliſh-built veſſels, which were rigged in the Engliſh way. They ſhowed the Engliſh flag, and had their ſailors, at leaſt thoſe we ſaw on deck, dreſſed like Engliſh. In ſhort, we did not perceive our miſtake till we obſerved them pointing their guns. We had not ſtrength ſufficient to reſiſt, and therefore our governor gave orders, that as ſoon as they ſhould begin to fire, the Britiſh flag ſhould be ſtruck, and a flag of truce hoiſted. Accordingly this was done, but ſtill they continued firing, and did much damage, both within and without the town. They killed two people and wounded three or four. But, as we did not underſtand the meaning of this proceeding, we aſked them for an explanation; and they anſwered us, that we ſhould diſplay the flag of liberty, as a proof of our ſubmiſſion. We aſſured them that it ſhould already have been done, if we had had any, which terminated the hoſtilities from the ſhips. In the mean time, moſt of the inhabitants had fled from the the town, having taken with them as much of their

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Wadſtrom, Part II. p. 280.

Sierra. property as they conveniently could in ſuch a hurry. I was with the governor, together with a number of others; but as ſoon as I was certain they were enemies, I went towards my own houſe with a view to ſave as much as poſſible of my property and natural collections; but was received in ſuch manner, that I could not venture to proceed. My houſe was ſituated near the ſhore, and unfortunately juſt oppoſite the frigate which fired. I ſaw the balls paſſing through the houſe, and heard them whizzing about my ears. I ſaw that I ſhould loſe all my property; but life was dearer to me, and I haſtened to the woods.

"In the afternoon the enemy landed, finding the town almoſt deſtitute of people, but rich in proviſions, clothing, and other ſtores. They began immediately to break open the houſes and to plunder. What they did not want, they deſtroyed, burnt, or threw into the river. They killed all the cattle and animals they found in the fields or ſtreets, yards, or elſewhere, not ſparing even aſſes, dogs, and cats. Theſe proceedings they continued the whole ſucceeding week, till they had entirely ruined our beautiful and proſpering colony; and when they found nothing more worth plundering, they ſet fire to the public buildings and all the houſes belonging to the Europeans; and burnt, as they ſaid, by miſtake nine or ten houſes of the coloniſts. In the mean time, they were not leſs active on the water. They ſent three of their veſſels to Bance iſland, an Engliſh ſlave factory higher up the river, which they plundered and burnt, together with ſome ſlave ſhips lying there. They took beſides about 10 or 12 prizes, including the company's veſſels. Moſt of theſe they unloaded and burnt. They took along with them alſo two of our armed veſſels, one of which was a large ſhip, laden with proviſions, and which had been long expected; but ſhe unfortunately arrived a few days too ſoon, and was taken with her whole cargo. We expected at leaſt to receive our private letters, but even this was refuſed, and they were thrown overboard. At laſt, after inflicting on us every hardſhip we could ſuffer, only ſparing our lives and the houſes of the coloniſts, they ſailed on the 13th of October laſt, at noon, proceeding downwards to the Gold Coaſt, and left us in the moſt dreadful ſituation, without proviſions, medicines, clothes, houſes, or furniture, &c. &c. and I fear much, that moſt of us ſhould have periſhed, had not our friends in the neighbourhood, both natives and Europeans, who were ſo happy as to eſcape the enemy, been ſo kind as to ſend us what they could ſpare. In the mean time, moſt of us have either been, or ſtill are, very ſick, and many have died for want of proper food and medicine. The worſt, however, is now paſt. At leaſt we are not in any want of proviſion, although of the coarſeſt kind, but are deſtitute of the moſt neceſſary articles and utenſils for the houſe, the table, and the kitchen."

It was thus that the Convention executed their purpoſe of *ſpreading light and liberty through the world*. The Sierra Leona colony was eſtabliſhed for no other end than to aboliſh the ſlave-trade, to enlighten the Africans, and to render them virtuous, rational, free, and happy; and thoſe powerful patrons of the rights of man deſtroyed that colony with many circumſtances of the moſt wanton cruelty. Though Mr Afzelius is a Swede, and ought therefore to have been protected by the laws of neutrality, they burnt his houſe with the reſt; deprived him of his trunks, his clothes, and his bed; deſtroyed the natural curioſities which he had collected at the hazard of his life; and carried away the inſtruments by means of which only he could collect more. It is with pleaſure, however, that we learn from the proceedings of the general court held on the 25th of February 1795, that the directors do not yet deſpair of the colony; and that they have adopted the moſt prudent meaſures to avert all ſuch calamities in future. That their benevolent labours may be finally crowned with ſucceſs is our earneſt prayer, in which we ſhall, doubtleſs, be joined by every good Chriſtian.

Sierra || Sifans.

SIERRA MORENA, mountains of Andaluſia in Spain.

SIEUR, a title of reſpect among the French, like that of *maſter* among us. It is much uſed by lawyers, as alſo by ſuperiors in their letters to inferiors.

SIFANTO, or SIPHANTO, an iſland of the Archipelago, to the weſt of Paros, to the north-eaſt of Milo, and to the ſouth-weſt of Serphanto. The air is ſo good here, that many of the inhabitants live to the age of 120; and their water, fruits, wild fowl, and poultry, are excellent, but more eſpecially the grapes. It abounds with marble and granite, and is one of the moſt fertile and beſt cultivated of theſe iſlands. The inhabitants employ themſelves in cultivating olive-trees and capers; and they have very good ſilk. They trade in figs, onions, wax, honey, and ſtraw-hats; and may be about 8000 in all. E. Long. 25. 15. N. Lat. 37. 9.

SI-FANS, or TOU-FANS, a people inhabiting the country on the weſt of China. Their country is only a continued ridge of mountains, incloſed by the rivers Hoang-ho on the north, Ya-long on the weſt, and Yang-tſe-kiang on the eaſt, between the 30th and 35th degrees of north latitude. *Groſier's General Deſcription of China*, vol. I. p. 203.

The Si-fans are divided into two kinds of people; the one are called by the Chineſe *Black Si-fans*, the other *Yellow*; names which are given them from the different colours of their tents. The black are the moſt clowniſh and wretched; they live in ſmall bodies, and are governed by petty chiefs, who all depend upon a greater.

The yellow Si-fans are ſubject to families, the oldeſt of which becomes a lama, and aſſumes the yellow dreſs. Theſe lama princes, who command in their reſpective diſtricts, have the power of trying cauſes, and puniſhing criminals; but their government is by no means burdenſome; provided certain honours are paid them, and they receive punctually the dues of the god Fo, which amount to very little, they moleſt none of their ſubjects. The greater part of the Si-fans live in tents; but ſome of them have houſes built of earth, and even brick. Their habitations are not contiguous; they form at moſt but ſome ſmall hamlets, conſiſting of five or ſix families. They feed a great number of flocks, and are in no want of any of the neceſſaries of life. The principal article of their trade is rhubarb, which their country produces in great abundance. Their horſes are ſmall; but they are well ſhaped, lively, and robuſt.

Theſe people are of a proud and independent ſpirit, and acknowledge with reluctance the ſuperiority of the Chineſe government, to which they have been ſubjected: when they are ſummoned by the mandarins, they rarely appear; but the government, for political reaſons, winks

Sigaultian Sign.

winks at this contempt, and endeavours to keep theſe intractable ſubjects under by mildneſs and moderation: it would, beſides, be difficult to employ rigorous means in order to reduce them to perfect obedience; their wild and frightful mountains (the tops of which are always covered with ſnow, even in the month of July) would afford them places of ſhelter, from which they could never be driven by force.

The cuſtoms of theſe mountaineers are totally different from thoſe of the Chineſe. It is, for example, an act of great politeneſs among them to preſent a white handkerchief of taffety or linen, when they accoſt any perſon whom they are deſirous of honouring. All their religion conſiſts in their adoration of the god Fo, to whom they have a ſingular attachment: their ſuperſtitious veneration extends even to his miniſters, on whom they have conſidered it as their duty to confer ſupreme power and the government of the nation.

SIGAULTIAN OPERATION, a method of delivery in caſes of difficult labour, firſt practiſed by M. Sigault. It conſiſts in enlarging the dimenſions of the pelvis, in order to procure a ſafe paſſage to the child without injuring the mother. See MIDWIFERY, chap. vii.

SIGESBECKIA, in botany: A genus of plants belonging to the claſs of ſyngeneſia, and to the order of polygamia ſuperflua; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. The receptacle is paleaceous; the pappus is wanting; the exterior calyx is pentaphyllous, proper, and ſpreading; the radius is halved. There are three ſpecies: 1. The *orientalis*, which is a native of India and China. 2. The *occidentalis*, which is a native of Virginia. 3. The *floſculoſa*, a native of Peru.

SIGETH, a town of Lower Hungary, and capital of a county of the ſame name. It is ſeated in a moraſs, and has a triple wall, with ditches full of water; and is defended by a citadel, being one of the ſtrongeſt places in Hungary. It now belongs to the houſe of Auſtria, and was retaken from the Turks in 1669, after it had been blocked up two years. In ſome maps it is called *Zigat*. E. Long. 18. 58. N. Lat. 46. 17.

SIGHING, an effort of nature, by which the lungs are put into greater motion, and more dilated, ſo that the blood paſſes more freely, and in greater quantity, to the left auricle, and thence to the ventricle. Hence we learn, ſays Dr Hales, how ſighing increaſes the force of the blood, and conſequently proportionably cheers and relieves nature, when oppreſſed by its too ſlow motion, which is the caſe of thoſe who are dejected and ſad.

SIGHT, or VISION. See ANATOMY, n° 142. and *Index* ſubjoined to OPTICS.

Imperfection of SIGHT with regard to Colours. Under the article COLOURS, is given an inſtance of a ſtrange deficiency of ſight in ſome people who could not diſtinguiſh between the different colours. In the Phil. Tranſ. Vol. LXVIII. p. 611. we have an account of a gentleman who could not diſtinguiſh a claret colour from black. Theſe imperfections are totally unaccountable from any thing we yet know concerning the nature of this ſenſe.

Second SIGHT. See *SECOND Sight*.

SIGN, in general, the mark or character of ſomething abſent or inviſible. See CHARACTER.

Among phyſicians, the term *ſign* denotes ſome appearance in the human body which ſerves to indicate or point out the condition of the patient with regard to health or diſeaſe.

Sign, Naval Signals.

SIGN, in algebra. See ALGEBRA, Part I.

SIGN, in aſtronomy, a conſtellation containing a 12th part of the zodiac. See ASTRONOMY, n° 318.

NAVAL SIGNALS. When we read at our fireſide the account of an engagement, or other intereſting operation of an army, our attention is generally ſo much engaged by the reſults, that we give but little to the movements which led to them, and produced them, and we ſeldom form to ourſelves any diſtinct notion of the conduct of the day. But a profeſſional man, or one accuſtomed to reflection, and who is not ſatisfied with the mere indulgence of eager curioſity, follows every regiment in its movements, endeavours to ſee their connection, and the influence which they have had on the fate of the day, and even to form to himſelf a general notion of the whole ſcene of action at its different intereſting periods. He looks with the eye of the general, and ſees his orders ſucceed or fail.

But few trouble themſelves farther about the narration. The movement is ordered; it is performed; and the fortune of the day is determined. Few think how all this is brought about; and when they are told that during the whole of the battle of Cuſtrin, Frederic the Great was in the upper room of a country inn, from whence he could view the whole field, while his aids de camp, on horſeback, waited his orders in the yard below, they are ſtruck with wonder, and can hardly conceive how it can be done: but, on reflection, they ſee the poſſibility of the thing. Their imagination accompanies the meſſenger from the inn yard to the ſcene of action; they hear the General's orders delivered, and they expect its execution.

But when we think for a moment on the ſituation of the commander of a fleet, confined on board one ſhip, and this ſhip as much, or more cloſely, engaged, than any other of the fleet; and when we reflect that here are no meſſengers ready to carry his orders to ſhips of the ſquadron at the diſtance of miles from him, and to deliver them with preciſion and diſtinctneſs, and that even if this were poſſible by ſending ſmall ſhips or boats, the viciſſitudes of wind and weather may render the communication ſo tedious that the favourable moment may be irretrievably loſt before the order can be conveyed.—When we think of all theſe circumſtances, our thoughts are bewildered, and we are ready to imagine that a ſea-battle is nothing but the unconnected ſtruggle of individual ſhips; and that when the admiral has once "cried havoc, and let ſlip the dogs of war," he has done all that his ſituation empowers him to do, and he muſt leave the fate of the day to the bravery and ſkill of his captains and ſailors.

Signals a language to the eye.

Yet it is in this ſituation, apparently the moſt unfavourable, that the orders of the commander can be conveyed, with a diſpatch that is not attainable in the operations of a land army. The ſcene of action is unincumbered, ſo that the eye of the General can behold the whole without interruption. The movements which it is poſſible to execute are few, and they are preciſe. A few words are ſufficient to order them, and then the mere fighting the ſhips muſt always be left to their reſpective commanders. This ſimplicity in the duty to be performed has enabled us to frame a language fully adequate to the buſineſs in hand, by which a correſpondence can be kept up as far as the eye can ſee. This is

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the language of SIGNALS, a language by writing, addreſſed to the eye, and which he that runneth may read. As in common writing certain arbitrary marks are agreed on to expreſs certain ſounds uſed in ſpeech, or rather, as in hieroglyphics certain arbitrary marks are agreed on to expreſs certain thoughts, or the ſubjects of theſe thoughts; ſo here certain exhibitions are made, which are agreed on to expreſs certain movements to be executed by the commander to whom they are addreſſed, and all are enjoined to keep their eyes fixed on the ſhip of the conductor of the fleet, that they may learn his will.

2 Uſed in ancient times,

It is ſcarcely poſſible for any number of ſhips to act in concert, without ſome ſuch mode of communication between the general and the commanders of private ſhips. We have no direct information of this circumſtance in the naval tactics of the ancient nations, the Greeks and Romans; yet the neceſſity of the thing is ſo apparent, that we cannot ſuppoſe it to have been omitted by the moſt ingenious and the moſt cultivated people who have appeared on the great theatre of the world; and we are perſuaded that Themiſtocles, Conon, and other renowned ſea commanders of Athens, had ſignals by which they directed the movements of their fleets. We read, that when Ægeus ſent his ſon Theſeus to Crete, it was agreed on, that if the ſhip ſhould bring the young prince back in ſafety, a white flag ſhould be diſplayed. But thoſe on board, in their joy for reviſiting their country after their perilous voyage, forgot to hoiſt the concerted ſignal. The anxious father was every day expecting the ſhip which ſhould bring back his darling ſon, and had gone to the ſhore to look out for her. He ſaw her, but without the ſignal agreed on. On which the old man threw himſelf into the ſea. We find, too, in the hiſtory of the Punic wars by Polybius, frequent alluſions to ſuch a mode of communication; and Ammianus Marcellinus ſpeaks of the *ſpeculatores* and *vexillarii*, who were on board the ſhips in the Adriatic. The coins both of Greece and Rome exhibit both flags and ſtreamers. In ſhort, we cannot doubt of the ancients having practiſed this hieroglyphical language. It is ſomewhat ſurpriſing that Lord Dudley, in his *Arcano del Mare*, in which he makes an oſtentatious diſplay of his knowledge of every thing connected with the ſea ſervice, makes no expreſs mention of this very eſſential piece of knowledge, although he muſt, by his long reſidence in Italy, have known the marine diſcipline of the Venetians and Genoeſe, the greateſt maritime powers then in Europe.

3 As well as in modern;

In the naval occurrences of modern Europe, mention is frequently made of ſignals. Indeed, as we have already obſerved, it ſeems impoſſible for a number of ſhips to act in any kind of concert, without ſome method of communication. Numberleſs ſituations muſt occur, when it would be impoſſible to convey orders or information by meſſengers from one ſhip to another, and coaſt and alarm ſignals had long been practiſed by every nation. The idea was, therefore, familiar. We find, in particular, that Queen Elizabeth, on occaſion of the expedition to Cadiz, ordered her ſecretaries to draw up inſtructions, which were to be communicated to the admiral, the general, and the five counſellors of war, and by them to be copied and tranſmitted to the ſeveral ſhips of the navy, not to be opened till they ſhould arrive in a certain latitude. It was on this occaſion, (ſays our hiſtorian Guthrie), "*that we meet with the firſt regular ſets of ſignals and orders to the commanders of the Engliſh fleet.*" But, till the movements of a fleet have attained ſome ſort of uniformity, regulated and connected by ſome principles of propriety, and agreed on by perſons in the habit of directing a number of ſhips, we may with confidence affirm that ſignals would be nothing but a parcel of arbitrary marks, appropriated to particular pieces of naval ſervice, ſuch as attacking the enemy, landing the ſoldiers, &c.; and that they would be conſidered merely as referring to the final reſult, but by no means pointing out the mode of execution, or directing the movements which were neceſſary for performing it.

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4 But firſt formed into a ſyſtem by James II. when duke of York.

It was James II. when duke of York, who firſt conſidered this practice as capable of being reduced into a ſyſtem, and who ſaw the importance of ſuch a compoſition. He, as well as the king his brother, had always ſhowed a great predilection for the ſea ſervice; and, when appointed admiral of England, he turned his whole attention to its improvement. He had ſtudied the art of war under Turenne, not as a paſtime, but as a ſcience, and was a favourite pupil of that moſt accompliſhed general. Turenne one day pointed him out, ſaying, "Behold one who will be one of the firſt princes and greateſt generals of Europe." When admiral of England, he endeavoured to introduce into the maritime ſervice all thoſe principles of concert and arrangement which made a number of individual regiments and ſquadrons compoſe a great army. When he commanded in the Dutch war, he found a fleet to be little better than a collection of ſhips, on board of each of which the commander and his ſhip's company did their beſt to annoy the enemy, but with very little dependence on each other, or on the orders of the General; and in the different actions which the Engliſh fleet had with the Dutch, every thing was confuſion as ſoon as the battle began. It is remarkable that the famous penſionary De Witt, who from a ſtateſman became a navigator and a great ſea commander in a few weeks, made the ſame repreſentation to the States General on his return from his firſt campaign.

In the memoirs of James II. written by himſelf, we have the following paſſage: "1665. On the 15th of March the duke of York went to Gunfleet, the general rendezvous of the fleet, and haſtened their equipment. He ordered all the flag officers on board with him every morning, to agree on the order of battle and rank. In former battles, no order was kept, and this under the duke of York was the firſt in which fighting in a line and regular form of battle was obſerved."

This muſt be conſidered as full authority for giving the duke of York the honour of the invention. For whatever faults may be laid to the charge of this unfortunate prince, his word and honour ſtands unimpeached. And we are anxious to vindicate his claim to it, becauſe our neighbours the French, as uſual, would take the merit of this invention, and of the whole of naval tactics, to themſelves. True it is, that Colbert, the great and juſtly celebrated miniſter of Louis XIV. created a navy for his ambitious and vain-glorious maſter, and gave it a conſtitution which may be a model for other nations to copy. By his encouragement, men of the greateſt ſcientific eminence were engaged to contribute to its improvement: and they gave us the firſt treatiſes of naval evolutions. But it muſt ever be remembered, that our accompliſhed, though miſguided ſovereign, was then reſiding

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residing at the court of Louis; that he had formerly acted in concert with the French as a commander and flag officer, and was at this very time aiding them with his knowledge of sea affairs. In the memorable day at La Hogue, the gallant Russel, observing one of Tourville's movements, exclaimed, "There! they have got Pepys† among them." This anecdote we give on the authority of a friend, who heard an old and respectable officer (Admiral Clinton) say, that he had it from a gentleman who was in the action, and heard the words spoken; and we trust that our readers will not be displeased at having this matter of general opinion established on some good grounds.

† Pepys was secretary to the duke of York.

5 Wonderful simplicity of his system;

It was on this occasion, then, that the duke of York made the movements and evolutions of a fleet the object of his particular study, reduced them to a system, and composed that "System of Sailing and Fighting Instructions," which has ever since been considered as the code of discipline for the British navy, and which has been adopted by our rivals and neighbours as the foundation of their naval tactics. It does great honour to its author, although its merit will not appear very eminent to a careless surveyor, on account of that very simplicity which constitutes its chief excellence. It is unquestionably the result of much sagacious reflection and painful combination of innumerable circumstances, all of which have their influence; and it is remarkable, that although succeeding commanders have improved the subject by several subordinate additions, no change has to this day been made in its general principles or maxims of evolution.

Till some such code be established, it is evident that signals can be nothing but arbitrary and unconnected hieroglyphics, to be learned by rote, and retained by memory, without any exercise of the judgment; and the acquisition of this branch of nautical skill must be a more irksome task than that of learning the Chinese writing. But such a code being once settled, the character in which it may be expressed becomes a matter of rational discussion.

Accordingly, the sailing and fighting instructions of the duke of York were accompanied by a set of signals for directing the chief or most frequent movements of the fleet. These also were contrived with so much judgment, and such attention to distinctness, simplicity, and propriety, that there has hardly been any change found necessary; and they are still retained in the British navy as the usual signals in all cases when we are not anxious to conceal our movements from an enemy.

6 Yet as an art has since his time received considerable improvements.

Notwithstanding this acknowledged merit of the duke of York's signals, it must be admitted that great improvements have been made on this subject, considered as an art. The art military has, in the course of a century past, become almost an appropriate calling, and has therefore been made the peculiar study of its professors. Our rivals the French were sooner, and more formally, placed in this situation, and the ministers of Louis XIV. took infinite and most judicious pains to make their military men superior to all others by their academical education. A more scientific turn was given to their education, and the assistance of scientific men was liberally given them; and all the nations of Europe must acknowledge some obligations to them for information on every thing connected with the art of war. They have attended very much to this subject, have greatly improved it, and have even introduced a new principle into the art; and by this means have reduced it to the most simple form of reference to the code of sailing and fighting instructions, by making the signals immediately expressive, not of orders, but of simple numbers. These numbers being prefixed to the various articles of the code of instructions, the officer who sees a signal thrown out by the admiral reads the number, and reports it to his captain, perhaps without knowing to what it relates. Thus simplicity and secrecy, with an unlimited power of variation, are combined. We believe that M. de la Bourdonnais, a brave and intelligent officer, during the war 1758, was the author of this ingenious thought.

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We do not propose to give a system of British signals. This would evidently be improper. But we shall show our readers the practicability of this curious language, the extent to which it may be carried, and the methods which may be practised in accomplishing this purpose. This may make it an object of attention to scientific men, who can improve it; and the young officer will not only be able to read the orders of the commander in chief, but will not be at a loss, should circumstances place him in a situation where he must issue orders to others.

Signals may be divided into,

I. Day Signals.

II. Night Signals; and,

III. Signals in a Fog.

They must also be distinguished into, 1. Signals of Evolution, addressed to the whole Fleet, or to Squadrons of the fleet, or to Divisions of these squadrons. 2. Signals of Movements to be made by particular ships; and, 3. Signals of Service, which may be either general or particular.

7 During an engagement the signals of the Admiral are repeated by frigates stationed out of the line.

The great extent of a large fleet, the smoke in time of battle, and the situation of the commander in chief, who is commonly in the midst of the greatest confusion and hottest fire, frequently makes it very difficult for the officers of distant ships to perceive his signals with distinctness, Frigates, therefore, are stationed out of the line, to windward or to leeward, whose sole office it is to observe the admiral's signals, and instantly to repeat them. The eyes of all the signal officers in the private ships of war are directed to the repeating frigates, as well as to the admiral; and the officers of the repeating frigate, having no other duty, observe the admiral incessantly, and, being unembarrassed by the action, can display the signal with deliberation, so that it may be very distinctly seen. Being minutely acquainted with the substitutions which must be made on board the admiral when his masts and rigging are in disorder, his (perhaps imperfect) signal is exhibited by the repeating frigate in its proper form, so as to be easily understood. And to facilitate this communication, the commanders of the different squadrons repeat the signals of the commander in chief, and the commanders of division repeat the signals of the commanders of their squadron.

8 Evolution-signals are preceded by a signal of advertisement, and accompanied with a directive signal.

Every evolution signal is preceded by a signal of Advertisement and Preparation, which is general, and frequently by a gun, to call attention; and when all the signals have been made which direct the different parts of that evolution, another signal is made, which marks the close of the complex signal, and divides it from others which may immediately follow it: and as the orders of the commander in chief may relate either to the movements of the whole fleet, those of a single division, or those

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thoſe of certain private ſhips, the EXECUTIVE SIGNAL, which dictates the particular movement, is accompanied by a DIRECTIVE SIGNAL, by which theſe ſhips are pointed out, to which the order is addreſſed.

9 Anſwered by the commander to whom they are addreſſed.

The commander of the ſhip to which any ſignal is addreſſed, is generally required to ſignify by a ſignal (which is general) that he has obſerved it. And if he does not thoroughly underſtand its meaning, he intimates this by another general ſignal. And here it is to be obſerved, that as ſoon as the ſignal is anſwered by the ſhips to which it is addreſſed, it is uſual to haul it down, to avoid the confuſion which might ariſe from others being hoiſted in the ſame place. The order remains till executed, notwithſtanding that the ſignal is hauled down.

10 Annulling ſignal.

It may happen that the commander who throws out the ſignal for any piece of ſervice, ſees reaſons for altering his plan. He intimates this by a general ANNULLING ſignal, accompanying the ſignal already given. This will frequently be more ſimple than to make the ſignals for the movements which would be required for re-eſtabliſhing the ſhips in their former ſituation.

All theſe things are of very eaſy comprehenſion, and require little thought for their contrivance. But when we come to the particular evolutions and movements, and to combine theſe with the circumſtances of ſituation in which the fleet may be at the time, it is evident, that much reflection is neceſſary for framing a body of ſignals which may be eaſily exhibited, diſtinctly perceived, and well underſtood, with little riſk of being miſtaken one for another. We ſhall take notice of the circumſtances which chiefly contribute to give them theſe qualities as we proceed in deſcribing their different claſſes.

I. *Of* DAY SIGNALS.

THESE are made by means of the ſhip's ſails, or by colours of various kinds.

Thoſe made with ſails are but few in number, and are almoſt neceſſarily limited to the ſituation of a fleet at anchor. Thus,

The following Signals	*uſually ſignify,*
Main top-gallant ſtayſail hoiſted	Officers and men belonging to the ſhip to come on board.
Fore top-ſail looſe	To prepare for ſailing.
Main top-ſail looſe	To unmoor.
Main top-ſail ſheets hauled home	To weigh.
Main top-ſail ſheets clewed up, and the yard hoiſted	Annul the former ſignal, and the ſhip to come to an anchor.
Top-gallant ſails looſe, and the ſheets flying	Diſcovering ſtrange ſails.
Main top-gallant ſail looſe and hoiſted. Topſail-yard down	Recal ſhips in chaſe.
Mizen top-ſail hoiſted, and the ſheets clewed up	Moor.

Before we proceed to the deſcription of the ſignals by means of colours, ſuch as FLAGS, BANNERS (or triangular flags), PENDANTS or VANES, we muſt take notice of the oſtenſible diſtinctions of the various diviſions and ſubdiviſions of a fleet, ſo that we may underſtand how the ſame ſignal may be addreſſed to a ſquadron, diviſion, or ſingle ſhip or ſhips. We ſuppoſe it known that a fleet of ſhips of war is diſtributed into three grand diviſions (which we ſhall term *ſquadrons*), called the *van*, *centre*, and *rear*. Theſe denominations have not always a relation to the one being more advanced than the other, either towards the enemy, or in the direction of their courſe.

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11 Meaning of the terms van, centre, and rear, in the line of battle at ſea.

In a land army, the poſition of every part is conceived from its reference to the enemy; and the reader, conceiving himſelf as facing the enemy, eaſily underſtands the terms *van*, *centre*, and *rear*, the *right* and *left* *wing*, &c. But the movements of a ſea army having a neceſſary dependence on the wind, they cannot be comprehended unleſs expreſſed in a language which keeps this circumſtance continually in view. The ſimpleſt and moſt eaſily conceived diſpoſition of a fleet, is that in which it is almoſt indiſpenſably obliged to form in order to engage an enemy. This is a ſtraight line, each ſhip directly a-head of its neighbour, and cloſe hauled. This is therefore called the *line of battle*. In this poſition, the two extremities of the fleet correſpond to the right and left wings of an army. Suppoſe this line to be in the direction eaſt and weſt, the wind blowing from the north-north-weſt, and therefore the fleet on the ſtarboard tack; the ſhips heads are to the weſt, and the weſtermoſt diviſion is undoubtedly the van of the fleet, and the eaſtermoſt diviſion is the rear. And it is in conformity to this arrangement and ſituation that the LIST OF THE FLEET is drawn up. But the ſhips may be on the ſame eaſt and weſt line, cloſe hauled, with their heads to the weſt, but the wind blowing from the ſouth-ſouth-weſt. They muſt therefore be on the larboard tack. The ſame ſhips, and the ſame diviſion, are ſtill, in fact, the van of the fleet. But ſuppoſe the ſhips heads to be to the eaſtward, and that they are cloſe hauled, having the wind from the ſouth-ſouth-eaſt or the north-north-eaſt, the ſhips which were the real van on both tacks in the former ſituation are now, in fact, the rear on both tacks; yet they retain the denomination of the *van ſquadron* of this fleet, and are under the immediate direction of the officer of the ſecond rank, while the other extremity is under the direction of the third officer. This ſubordination therefore is rather an arrangement of rank and precedence than of evolution. It is, however, conſidered as the NATURAL ORDER to which the general ſignals muſt be accommodated. For this reaſon, the diviſion which is denominated *van* in the liſt of this fleet, is *generally* made to lead the fleet when in the line of battle on the ſtarboard tack, and to form the *weathermoſt* column in *the order of ſailing in columns*; and, in general, it occupies that ſtation from which it can moſt eaſily paſs into the place of the leading diviſion on the ſtarboard line of battle ahead. Although this is a technical nicety of language, and may frequently puzzle a landſman in reading an account of naval operations, the reflecting and intelligent reader will ſee the propriety of retaining this mode of conceiving the ſubordinate arrangement of a fleet, and will comprehend the employment of the ſignals which are neceſſary for re-eſtabliſhing this arrangement, or directing the movements while another arrangement is retained.

This being underſtood, it is eaſy to contrive various methods

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methods of diſtinguiſhing every ſhip by the place which ſhe occupies in the fleet, both with reſpect to the whole line, with reſpect to the particular ſquadron, the particular diviſion of that ſquadron, and the particular place in that diviſion. This may be done by a combination of the poſition and colour of the pendants and vanes of each ſhip. Thus the colour of the pendants may indicate the ſquadron, their poſition or maſt on which they are hoiſted may mark the diviſion of that ſquadron, and a diſtinguiſhing vane may mark the place of the private ſhip in her own diviſion. The advantages attending this method are many. In a large fleet it would hardly be poſſible for the commander in chief to find a ſufficient variety of ſingle ſignals to mark the ſhip to which an order is addreſſed, by hoiſting it along with the ſignal appropriated to the intended movement. But by this contrivance one-third part of theſe ſignals of addreſs is ſufficient. It alſo enables the commander in chief to order a general change of poſition by a ſingle ſignal, which otherwiſe would require ſeveral. Thus, ſuppoſe that the fore, main, and mizen maſts, are appropriated (with the proper modifications) for exhibiting the ſignals addreſſed to the van, the centre, and the rear ſquadrons of the fleet, and that a red, a white, and a blue flag, are choſen for the diſtinguiſhing flags of the officers commanding theſe ſquadrons; then, if the commander in chief ſhall hoiſt a red flag at his mizen top-gallant maſt head, it muſt direct the van ſquadron to take the poſition then occupied by the rear ſquadron, the evolution neceſſary for accompliſhing this end being ſuppoſed known by the commander of the ſquadron, who will immediately make the neceſſary ſignals to the ſquadron under his particular direction. In the ſame manner, the diſtinguiſhing ſignal for the leading ſhip of a ſquadron being hoiſted along with the ſignal of addreſs to the whole fleet, and the ſignal for any particular ſervice, will cauſe the three or the nine leading ſhips to execute that order, &c. &c.

12 How ſignals are addreſſed to each of theſe diviſions.

All that has been ſaid hitherto may be conſidered as ſo many preparations for the real iſſuing of orders by the commander in chief. The moſt difficult part of the language remains, viz. to invent a number of ſignals which ſhall correſpond to that almoſt infinite variety of movements and ſervices which muſt be performed.

13 Eſſential qualities of ſignals are diſtinctneſs,

Diſtinctneſs, ſimplicity, and propriety, are the three eſſential qualities of all ſignals. A ſignal muſt be ſome object eaſily ſeen, ſtrongly marked, ſo that it may be readily underſtood, with little riſk of its being miſtaken for another. When made by flags, banners, or pendants, they muſt be of the fulleſt colours, and ſtrongeſt contraſts. The ſhips are frequently at a very great diſtance, ſo that the intervening air occaſions a great degradation of colour. They are ſeen between the eye and a very variable ſky; and in this ſituation, eſpecially in the morning or evening, or a dark day, it is not eaſy to diſtinguiſh one full colour from another, all of them approaching to the appearance of a black. At the diſtance of a very few miles hardly any full colours can be diſtinguiſhed but a ſcarlet and a blue. Red, blue, yellow, and white, are the colours which can be diſtinguiſhed at greater diſtances than any others, and are therefore the only colours admitted as ſignals. Even theſe are ſometimes diſtinguiſhed with difficulty. A yellow is often confounded with a dirty white, and a blue with a red. All other dark colours are found totally unfit. But as theſe afford but a ſmall variety, we muſt combine them in one flag, by making it ſtriped, ſpotted, or chequered, taking care that the oppoſition of colour may be as great as poſſible, and that the pieces of which the flags are made up may not be too minute. Red muſt never be ſtriped nor ſpotted with blue, and the ſtripes, ſpots, or chequers, ſhould never be leſs than one-third of the breadth of the flag. Plate CCCCLXVI. is a ſelection by an officer of experience as a ſet very eaſily recogniſed, and little liable to be confounded. Their colours are repreſented by hatching, in the ſame manner as in heraldry (See HERALDRY).

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Difference of ſhape, as flags, banners, or pendants, is another diſtinction by which the expreſſion may be varied. And in doing this, we muſt recollect, that in light winds it may be difficult to diſtinguiſh a flag from a banner, as neither are fully diſplayed for want of wind to detach the fly from the ſtaff.

14 Simplicity.

And, laſtly, ſignals may be varied by their poſition, which may be on any lofty and well detached part of the maſts, yards, or rigging.

Simplicity is an eminent property in all ſignals. They are addreſſed to perſons not much accuſtomed to combinations, and who are probably much occupied by other preſſing duties. It were to be wiſhed that every piece of ſervice could be indicated by a ſingle flag. This is peculiarly deſirable with reſpect to the ſignals uſed in time of battle. The rapid ſucceſſion of events on this occaſion call for a multitude of orders from the commander in chief, and his ſhip is frequently clad over with flags and pendants, ſo that it is exceedingly difficult for the ſignal officer of a private ſhip to diſtinguiſh the different groups, each of which make a particular ſignal.

15 And propriety.

Theſe conſiderations are the foundation of a certain *propriety* in ſignals, which directs us to a choice among marks which appear altogether arbitrary. Signals which run any riſk of being confounded, on account of ſome reſemblance, or becauſe their poſition hinders us from immediately perceiving their difference, ſhould be appropriated to pieces of ſervice which are hardly poſſible to be executed, or can hardly be wanted, in the ſame ſituation. No bad conſequence could eaſily reſult though the ſignal for *coming to cloſer action* ſhould reſemble that for *unmooring*, becauſe the preſent ſituation of the ſhips makes the laſt operation impoſſible or abſurd. Such conſiderations direct us to ſelect for battle ſignals, thoſe which are of eaſieſt exhibition, are the moſt ſimple, and have the leaſt dependence on the circumſtance of poſition; ſo that their ſignification may not be affected by the damages ſuſtained in the maſts or rigging of the flag ſhip. Such ſignals as are leſs eaſily ſeen at a diſtance, ſhould be appropriated to orders which can occur only in the middle of the fleet, &c. &c. Signals which are made to the admiral by private ſhips may be the ſame with ſignals of command from the flag ſhip, which will conſiderably diminiſh the number of ſignals perfectly different from each other.

16 By what means ſignals are diſtinctly conveyed.

With all theſe attentions and precautions a ſyſtem of ſignals is at laſt made up, fitted to the code of ſailing and fighting inſtructions. It is accompanied by another ſmall ſet for the duty of convoys. It muſt be engroſſed in two books; one for the officer of the flag ſhip, who is to make the ſignals, and the other is

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delivered to every private ſhip. In the firſt, the evolutions, movements, and other operations of ſervice, are ſet down in one column, and their correſponding ſignals in another. The firſt column is arranged, either alphabetically, by the diſtinguiſhing phraſe, or ſyſtematically, according to the arrangement of the ſailing and fighting inſtructions. The officer whoſe duty it is to make the ſignals, turns to this column for the order which he is to communicate, and in the other column he finds the appropriated ſignal.

17 And underſtood.

In the other book, which is conſulted for the interpretation of the ſignals, they are arranged in the leading column, either by the flags, or by the places of their exhibition. The firſt is the beſt method, becauſe the derangement of the flag ſhip's maſts and rigging in time of action may occaſion a change in the place of the ſignal.

18 The art of ſignals much improved ſince the publication of the *Tactique Navale.*

The *Tactique Navale* of the Chevalier de Morogues contains a very full and elaborate treatiſe on ſignals. We recommend this work to every ſea-officer, as full of inſtruction. The art of ſignals has been greatly ſimplified ſince the publication of this work, but we cannot but aſcribe much of the improvements to it. We believe that the author is the inventor of that ſyſtematic manner of addreſſing the order or *effective ſignal* to the different ſquadrons and diviſions of the fleet, by which the art of ſignals is made more conciſe, the execution of orders is rendered more ſyſtematic, and the commanders of private ſhips are accuſtomed to conſider themſelves as parts of an army, with a mutual dependence and connection. We are ready enough to acknowledge the ſuperiority of the French in manœuvring, but we affect to conſider this as an imputation on their courage. Nothing can be more unjuſt; and dear-bought experience ſhould long ere now have taught us the value of this ſuperiority. What avails that courage which we would willingly arrogate to ourſelves, if we cannot come to action with our enemy, or muſt do it in a ſituation in which it is almoſt impoſſible to ſucceed, and which needleſsly throws away the lives of our gallant crews? Yet this muſt happen, if our admirals do not make evolutions their careful ſtudy, and our captains do not habituate themſelves, from their firſt hoiſting a pendant, to conſider their own ſhip as connected with the moſt remote ſhip in the line. We cannot think that this view of their ſituation would in the leaſt leſſen the character which they have ſo juſtly acquired, of fighting their ſhip with a courage and firmneſs unequalled by thoſe of any other nation. And we may add, that it is only by ſuch a rational ſtudy of their profeſſion, that the gentleman can be diſtinguiſhed from the mercenary commander of a privateer.

II. Night Signals.

It is evident, that the communication of orders by night muſt be more difficult and more imperfect than by day. We muſt, in general, content ourſelves with ſuch orders as are neceſſary for keeping the fleet together, by directing the more general movements and evolutions which any change of circumſtances may render neceſſary. And here the diviſion and ſubordinate arrangement of the fleet is of indiſpenſable neceſſity, it being hardly poſſible to particulariſe every ſhip by a ſignal of addreſs, or to ſee her ſituation. The orders are therefore addreſſed to the commanders of the different diviſions, each of whom is diſtinguiſhed by his poop and top-lights, and is in the midſt of, and not very remote from, the ſhips under his more particular charge. Yet even in this unfavourable ſituation, it is frequently neceſſary to order the movements of particular ſhips. Actions during the night are not uncommon. Purſuits and rallyings are ſtill oftener carried on at this time. The common dangers of the ſea are as frequent and more diſaſtrous. The ſyſtem of ſignals therefore is very incomplete till this part be accompliſhed.

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Night ſignals muſt be made by guns, or by lights, or by both combined.

19 How gun-ſignals may be varied.

Gun-ſignals are ſuſceptible of variety both in number and in diſpoſition. The only diſtinct variation which can be made in this diſpoſition, is by means of the time elapſed between the diſcharges. This will eaſily admit of three varieties, ſlow, moderate, and quick.—Half-minute guns are as ſlow as can eaſily be liſtened to as appertaining to one ſignal. Quarter-minute guns are much better, and admit of two very diſtinct ſubdiviſions. When the gunners, therefore, are well trained to this ſervice (eſpecially ſince the employment of firelocks for cannon), intervals of 15 or 12 ſeconds may be taken for ſlow firing, 8 or 10 ſeconds for moderate, and 4 or 5 ſeconds for quick firing. If theſe could be reduced one half, and made with certainty and preciſion, the expreſſion would be incomparably more diſtinct. A very ſmall number of firings varied in this way will give a conſiderable number of ſignals. Thus five guns, with the variety of only quick and moderate, will give 20 very diſtinguiſhable ſignals. The ſame principle muſt be attended to here as in the flag ſignals. The moſt ſimple muſt be appropriated to the moſt important orders, ſuch as occur in the worſt weather, or ſuch as are moſt liable to be miſtaken. Quick firing ſhould not make part of a ſignal to a very diſtant ſhip, becauſe the noiſe of a gun at a great diſtance is a lengthened ſound, and two of them, with a very ſhort interval, are apt to coaleſce into one long continued ſound. This mode of varying gun-ſignals by the time muſt therefore be employed with great caution, and we muſt be very certain of the ſteady performance of the gunners.

Note, that a preparatory ſignal or advertiſement that an effective ſignal is to be made, is a very neceſſary circumſtance. It is uſual (at leaſt in hard weather) to make this by a double diſcharge, with an interval of half a ſecond, or at moſt a ſecond.

Gun-ſignals are ſeldom made alone, except in ordinary ſituations and moderate weather; becauſe accident may derange them, and inattention may cauſe them to eſcape notice, and, once made, they are over, and their repetition would change their meaning. They are alſo improper on an enemy's coaſt, or where an enemy's cruiſers or fleets may be expected.

20 Signals by lights.

Signals by lights are either made with LIGHTS ſimply ſo called, *i. e.* lanthorns ſhown in different parts of the ſhip, or by rockets. Lights may differ by number, and by poſition, and alſo by figure. For the flag ſhip always carrying poop or top-lights, or both, preſents an object in the darkeſt night, ſo that we can tell whether the additional lights are exhibited about the mainmaſt, the foremaſt, the mizenmaſt, &c. And if the lights ſhown from any of theſe ſituations are arranged in certain diſtinguiſhable ſituations in reſpect to each other, the

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number of signals may be greatly increased. Thus three lights may be in a vertical line, or in a horizontal line, or in a triangle, and the point of this triangle may be up, or down, or forward, or aft, and thus may have many significations.

Lights are also exhibited by false fires or rockets: These can be varied by number, and by such differences of appearance as to make them very distinguishable. Rockets may be with stars, with rain fire, or simple squibs.

21 These two species of signals may be combined.

By varying and combining these, a very great number of signals may be produced, fully sufficient to direct every general movement or evolution, or any ordinary and important service. The Chevalier de Morogues has given a specimen of such a system of night signals, into which he has even introduced signals of address or direction to every ship of a large fleet; and has also given signals of number, by which depths of soundings, points of the compass, and other things of this kind, may be expressed both easily and distinctly. He has made the signals by rockets perfectly similar in point of number to those by lanthorns, so that the commander can take either; a choice which may have its use, because the signals by rockets may cause the presence of a fleet to be more extensively known than may be convenient.

22 General observations concerning night signals.

The commander in chief will inform the fleet by signal, that guns, or perhaps rockets, are not to be used that night. This signal, at the same time, directs the fleet to close the line or columns, that the light signals may be better observed.

It is indeed a general rule to show as few lights as possible; and the commander frequently puts out his own poop and top-lights, only showing them from time to time, that his ships may keep around him.

The signal-lanthorns on board the flag ship, and a lanthorn kept in readiness on board of every private ship, to answer or acknowledge signals from the commander in chief, are all kept in bags, to conceal their lights till the moment they are fixed in their places, and the preparatory or advertising signal has been made.

The commander in chief sometimes orders by signal every ship to show a light for a minute or two, that he may judge of the position of the fleet; and the admiral's signal must always be acknowledged by those to whom it is addressed.

It is of particular importance that the fleet be kept together. Therefore the leading ships of the fleet, on either tack, are enjoined to acknowledge the signals of the commander in chief by a signal peculiar to their station. Thus the commander in chief learns the position of the extremities of his fleet.

In framing a set of night signals, great attention must be given to their position, that they be not obscured by the sails. The nature of the order to be given will frequently determine this. Thus, an order for the rear ships to make more sail, will naturally direct us to exhibit the signal at the mizen peek; and so of other pieces of service. Lanthorns exposed in groups, such as triangles, lozenges, &c. are commonly suspended at the corners of large frames of laths, at the distance of a fathom at least from each other. Attempts have been made to show lights of different colours; but the risk of mistake or failure in the composition at the laboratory, makes this rather hazardous. Coloured lanthorns are more certain; but when the glasses are made of a colour sufficiently intense, the vivacity of the light (which at no time is very great) is too much diminished. Besides, the very distance changes the colour exceedingly and unaccountably.

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III. *Of* Signals *in a* Fog.

These can be made only by noises, such as the firing of cannon and muskets, the beating of drums and ringing of bells, &c. Fog signals are the most difficult to contrive of any, and are susceptible of the least variety. The commander in chief is principally concerned to keep his fleet together; and unless something very urgent requires it, he will make no change in his course or rate of sailing. But a shift of wind or other causes may make this necessary. The changes which he will order, it will be prudent to regulate by some fixed rule, which is in general convenient. Thus, when a fleet is in the order of sailing upon a wind, and a fog comes on, the fleet will hold on the same course. If the wind should come a little more on the beam, the fleet will still keep close to the wind. Certain general rules of this kind being agreed on, no signals are necessary for keeping the fleet together; and the ships can separate or run foul of each other only by difference in their rate of sailing, or by inaccurate steerage. To prevent this, the commander in chief fires a gun from time to time, and the ships of the fleet judge of his situation and distance by the sound. The commanders of divisions fire guns, with some distinction from those of the commander in chief. This both informs the commander in chief of the position of his squadrons, and enables the private ships of each division to keep in the neighbourhood of their own flag ship. On board of every private ship the drum is beaten, or the bell is chimed, every quarter of an hour, according as the ship is on the starboard or larboard tack. By such contrivances, it is never difficult to keep a fleet in very good order when sailing on a wind. The wind is almost always moderate, and the ships keep under a very easy sail. It is much more difficult when going large, and separation can be prevented only by the most unwearied attention. The greatest risk is the falling in with strange ships steering another course.

23 By observing certain general rules signals during a fog are in many cases unnecessary.

But evolutions and other movements are frequently indispensable. The course must be changed by tacking or wearing, and other services must be performed. None, however, are admitted but the most probable, the most simple, and the most necessary.

24 How they are given when necessary.

The commander in chief first informs the fleet by the *preparatory fog signal*, that he is about to order an evolution, and that he is to direct it by *fog signals*. This precaution is indispensable to prevent mistakes. Along with this advertising signal he makes the signal of the movement intended. This not only calls the attention of the fleet, but makes the ships prepare for the precise execution of that movement. The commanders of divisions repeat the advertising signal, which informs their ships of their situation, and the private ships beat their drums or chime their bells. Thus the whole ships of the fleet close a little, and become a little better acquainted with their mutual position. It is now understood that a movement is to be made precisely a quarter of an hour after the advertisement. At

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the expiration of this time, the effective signal for this movement is made by the commander in chief, and must be instantly repeated by the commanders of divisions, and then the movement must be made by each ship, according to the sailing and fighting instructions. This must be done with the utmost attention and precision, because it produces a prodigious change in the relative position of the ships; and even although the good sense of the commander in chief will select such movements for accomplishing his purpose as produce the smallest alterations, and the least risk of separation or running foul of each other; it is still extremely difficult to avoid these misfortunes. To prevent this as much as possible, each ship which has executed the movement, or which has come on a course thwarting that of the fleet, intimates this by a signal properly adapted, often adding the signal of the tack on which it is now standing, and even its particular signal of recognizance. This is particularly incumbent on the flag ships and the leading ships of each division.

After a reasonable interval, the commander in chief will make proper signals for bringing the fleet to a knowledge of their reunion in this new position.

25 Improper to publish a particular account of signals.

This must serve for a general account of the circumstances which must be attended to in framing a code of signals. The arbitrary characters in which the language is written must be left to the sagacity of the gentlemen of the profession. It must be observed, that the stratagems of war make secrecy very necessary. It may be of immense hazard if the enemy should understand our signals. In time of battle it might frequently frustrate our attempts to destroy them, and at all times would enable them to escape, or to throw us into disorder. Every commander of a squadron, therefore, issues private signals, suited to his particular destination; and therefore it is necessary that our code of signals be susceptible of endless variations. This is exceedingly easy without any increase of their number. The commander needs only intimate that such and such a signal is so and so changed in its meaning during his command.

26 Signals may be made the immediate expressions of numbers.

We cannot leave this article without returning to an observation which we made almost in the beginning, viz. that the system of signals, or, to speak more properly, the manner of framing this system, has received much improvement from the gentlemen of the French navy, and particularly from the most ingenious thought of M. de la Bourdonnais, of making the signals the immediate expressions of *numbers* only, which numbers may be afterwards used to indicate any order whatever. We shall present our readers with a scheme or two of the manner in which this may be done for all signals, both day, night, and fog. This alone may be considered as a system of signals, and is equally applicable to every kind of information at a distance. Without detracting in the smallest degree from the praise due to M. de la Bourdonnais, we must observe, that this principle of *notation* is of much older date. Bishop Wilkins, in his Secret and Swift Messenger, expressly recommends it, and gives specimens of the manner of execution; so does Dr Hooke in some of his proposals to the Royal Society. Gaspar Schottus also mentions it in his *Technica Curiosa*; and Kircher, among others of his Curious Projects.

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M. de la Bourdonnais's method is as follows:

He chooses pendants for his effective signals, because they are the most easily displayed in the proper order. Several pendants, making part of one signal, may be hoisted by one hallyard, being stopped on it at the distance of four or six feet from each other. If it be found proper to throw out another signal at the same time and place, they are separated by a red pendant without a point. His colours are chosen with judgement, being very distinctly recognised, and not liable to be confounded with the addressing signals appropriated to the different ships of the fleet. They are,

27 M. de la Bourdonnais's method for doing this

For N° 1.	Red.	For N° 6.	Red, with blue tail.
2.	White.	7.	White, with blue tail.
3	Blue.	8.	White, with red tail.
4.	Yellow.	9.	Blue, with yellow tail.
5.	Red, with white tail.	0.	Yellow, with blue tail.

Three sets of such pendants will express every number under a thousand, by hoisting one above the other, and reckoning the uppermost hundreds, the next below it tens, and the lowest units. Thus the number 643 will be expressed by a pendant red with blue tail, a yellow pendant below it, and a blue one below the last.

This method has great advantages. The signals may be hoisted in any place where best seen, and therefore the signification is not affected by the derangement of the flag ship's masts and rigging. And by appropriating the smaller numbers to the battle signals, they are more simple, requiring fewer pendants.

28 Might be rendered much simpler by using fewer colours.

As this method requires a particular set of colours, it has its inconveniences. An admiral is often obliged to shift his flag, even in time of action. He cannot easily take the colours along with him. It is therefore better to make use of such colours as every private ship is provided with. One set of 11 will do, with the addition of three, at most of four pendants, of singular make, to mark 100, 200, 300, 400. Two of these flags, one above the other, will express any number under 100, by using the 11th as a substitute for any flag that should be repeated. Thus the 11th flag, along with the flag for eight or for six, will express the number 88 or 66, &c. Thus we are able to express every number below 500, and this is sufficient for a very large code of signals.

And in order to diminish as much as possible the number of these compound signals, it will be proper that a number of single flag signals be preserved, and even varied by circumstances of position, for orders which are of very frequent occurrence, and which can hardly occur in situations where any obstructions are occasioned by loss of masts, &c. And farther, to avoid all chance of mistake, a particular signal can be added, intimating that the signals now exhibited are numerary signals; or, which is still better, all signals may be considered as numerary signals; and those which we have just now called *single flag signals* may be set down opposite to, or as expressing, the largest numbers of the code.

This method requires the signal of advertisement, the annulling signal, the signal of address to the particular ship or division, the signal of acknowledgment, the signal of indistinctness, of distress, of danger, and

one

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one or two more which, in every method, must be employed.

29 Another method of expressing numbers by fewer colours,

Another method of expressing numbers with fewer colours is as follows: Let the flags be A, B, C, D, E, F, and arrange them as follows:

	A	B	C	D	E	F
	1	2	3	4	5	6
A	7	8	9	10	11	12
B	13	14	15	16	17	18
C	19	20	21	22	23	24
D	25	26	27	28	29	30
E	31	32	33	34	35	36
F	37	38	39	40	41	42

The number expressed by any pair of flags is found in the intersection of the horizontal and perpendicular columns. Thus the flag D, hoisted along with and above the flag F, expresses the number 40, &c. In order to express a greater number (but not exceeding 84) suppose 75, hoist the flags $\frac{C}{E}$, which expresses 37, or 75, wanting 42, and above them a flag or signal G, which alone expresses 42.

30 Which may be also improved.

This method may be still farther improved by arranging the flags thus:

	A	B	C	D	E	F
	1	2	3	4	5	6
A	7	8	9	10	11	12
B	—	13	14	15	16	17
C	—	—	18	19	20	21
D	—	—	—	22	23	24
E	—	—	—	—	25	26
F	—	—	—	—	—	27

In this last method the signification of the signal is totally independent of the position of the flags. In whatever parts of the ship the flags D and E are seen, they express the number 23. This would suit battle signals.

31 A third method.

Another method still may be taken. Flags hoisted anywhere on the foremast may be accounted units, those on the mainmast tens, and those on the mizenmast hundreds. Thus numeral signals may be made by a ship dismasted, or having only poles in their place.

Many other ways may be contrived for expressing numbers by colours, and there is great room for exercising the judgment of the contriver. For it must always be remembered, that these signals must be accompanied with a signal by which it is addressed to some particular ship or division of the fleet, and it may be difficult to connect the one with the other, which is perhaps shown in another place, and along with other executive signals.

32 Advantages of numeral signals.

One great advantage of these numeral signals is, that they may be changed in their signification at pleasure. Thus, in the first method, it can be settled, that on Sundays the colours A, B, C, D, &c. express the cyphers 1, 2, 3, 4, &c. but that on Mondays they express the cyphers 0, 1, 2, 3, &c. and on Tuesdays the cyphers 9, 0, 1, 2, &c.; and so on through all the days of the week. This mean of secrecy is mentioned by Dr Hooke for the coast and alarm signals, where, by the by, he shews a method for conveying intelligence over land very similar to what is now practised by the French with their telegraph.

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It is equally easy to express numbers by night signals. Thus M. de la Bourdonnais proposes, that one discharge of a great gun shall express 7, and that 1, 2, 3, 4, 5, 6 shall be expressed by lights. Therefore, to express 24, we must fire three guns, and show three lights. This is the most perfect of all forms of night and fog signals. For both the manner of firing guns and of exhibiting lights may be varied to a sufficient extent with very few guns or lights, and with great distinctness.

33 Numbers may be also expressed by night signals.

Thus, for guns. Let F mark the firing of a single gun at moderate intervals, and *ff* a double gun, that is, two discharged at the interval of a second. We may express numbers thus:

1	F.
2	F, F.
3	F, F, F.
4	F, F, F, F.
5	F, *ff*.
6	F, F, *ff*.
7	F, *ff*, F.
8	F, *ff*, F, F.
9	F, *ff*, F, *ff*.
10	*ff*.
100, &c.	*ff*, *ff*, or *fff*.

It might be done with fewer guns if the *ff* were admitted as the first firing. But it seems better to begin always with the single gun, and thus the double gun beginning a signal distinguishes the tens, &c.

In like manner, a small number of lights will admit of a great variety of very distinct positions, which may serve for all signals to ships not very remote from the commander in chief. For orders to be understood at a very great distance, it will be proper to appropriate the numbers which are indicated by signals made with rockets. These can be varied in number and kind to a sufficient extent, so as to be very easily distinguished and understood. It is sufficient to have shown how the whole, or nearly the whole, notation of signals may be limited to the expression of numbers.

34 Concluding remarks.

We have taken little notice of the signals made by private ships to the commander in chief. This is a very easy business, because there is little risk of confounding them with other signals. Nor have we spoken of signals from the flag ships whose ultimate interpretation is number, as when ships are directed to change their course so many points. Those also are easily contrived in any of the methods already described: also when a private ship wishes to inform the commander in chief that soundings are found at so many fathoms. In like manner, by numbering the points of the compass, the admiral can direct to chace to any one of them, or may be informed of strange ships being seen in any quarter, and what is their number.

Signals by the Drum, made use of, in the exercise of the army, instead of the word of command, viz.

Signals.	*Operations.*
A short roll, -	To caution.
A flam, -	To perform any distinct thing.
To arms, -	To form the line or battalion.
The march, -	To advance, except when intended for a salute.
The quick march,	To advance quick.
The point of war,	To march and charge.

Signature, Signet.

The retreat, -	To retreat.
Drum ceasing, -	To halt.
Two short rolls,	To perform the flank firing.
The dragoon march,	To open the battalion.
The grenadier march,	To form the column.
The troop, -	To double divisions.
The long roll, -	To form the square.
The grenadier march,	To reduce the square to the column.
The preparative, -	To make ready and fire.
The general, -	To cease firing.
Two long rolls, -	To bring or lodge the colours.

SIGNATURE, a sign or mark impressed upon any thing, whether by nature or art. Such is the general signification of the word; but in the plural number it has been used, in a particular sense, to denote those external marks by which physiognomists and other dabblers in the occult sciences pretend to discover the nature and internal qualities of every thing on which they are found. According to Lavater, every corporeal object is characterized by signatures peculiar to itself.

The doctrine of signatures, like alchemy and astrology, was very prevalent during the 15th and 16th centuries; and was considered as one of the occult sciences which conferred no small degree of honour on their respective professors. Some of these philosophers, as they thought fit to style themselves, maintained that plants, minerals, and animals, but particularly plants, had signatures impressed on them by the hand of nature, indicating to the adept the *therapeutic* uses to which they might be applied. Others, such as the mystic theosophists and chemists of that day, proceeded much farther in absurdity, maintaining that every substance in nature had either *external* signatures immediately discernible, or *internal* signatures, which, when brought into view by fire or menstrua, denoted its connection with some siderial or celestial archetype. Of the doctrine of signatures, as it relates merely to the therapeutic uses of plants and minerals, traces are to be found in the works of some of the greatest authors of antiquity; but the celestial signatures, we believe, were discovered only by the moonlight of the monkish ages. Pliny informs us*, that the marble called *aphites*, from its being spotted like a serpent, was discovered by those spots to be a sovereign remedy for the bite of that animal; and that the colour of the *hæmatites* or blood-stone intimated that it was fit to be employed to stop an hemorrhagy; but we do not recollect his attributing the virtues of these minerals to a siderial or celestial influence.

*Hist. Nat. lib. 34.

SIGNATURE, a signing of a person's name at the bottom of an act or deed written by his own hand.

SIGNATURE, in printing, is a letter put at the bottom of the first page at least, in each sheet, as a direction to the binder in folding, gathering, and collating, them. The signatures consist of the capital letters of the alphabet, which change in every sheet: if there be more sheets than letters in the alphabet, to the capital letter is added a small one of the same sort, as A a, B b; which are repeated as often as necessary. In large volumes it is easy to distinguish the number of alphabets, after the first three or four, by placing a figure before the signature, as 5 B, 6 B, &c.

SIGNET, one of the king's seals, made use of in sealing his private letters, and all grants that pass by bill signed under his majesty's hand: it is always in the custody of the secretaries of state.

Signet || Silesia.

SIGNET, in Scots law. See LAW, Part III. § 17.

SILENE, CATCHFLY, or *Viscous Campion*, in botany: A genus of plants belonging to the class of *decandria*, and order of *trigynia*; and in the natural system arranged under the 22d order, *caryophylleæ*. The calyx is ventricose; the petals are five in number, bifid and unguiculated, and crowned by a nectarium; the capsule is cylindrical, covered, and trilocular. There are 26 species, of which 7 are natives of Britain and Ireland. 1. *Anglica*, the small corn campion or catchfly. The stem is weak, hairy, and above a foot high; the leaves are oblong, and grow in pairs at the joints; the flowers are small, white, and entire; they stand on footstalks which issue from the alæ of the leaves; they are erect, alternate, single, and lateral. It grows in corn-fields, and flowers in June and July. 2. *Nutans*, Nottingham catchfly. The stem is about two feet high, and firm: the radical leaves are broad, obtuse, and grow in a tuft; those on the stem are narrow and acute: the flowers are white, and grow in lateral panicles; the petals are bifid and curled; the calyx is long, bellying a little, with ten longitudinal striæ. It grows in pastures, and flowers in June and July. 3. *Amœna*, sea-campion. The stem is two or three feet long, slender, procumbent, and branched alternately: the leaves are long and narrow: the flowers are white, and grow on opposite footstalks, three on each, in unilateral bunches: the calyx is hairy and purplish, and has ten angles. It grows on the south coast, and flowers in June and July. 4. *Conoidea*, greater corn catchfly, or campion. The leaves are narrow and soft; the calyx is conical, with 30 striæ; the flowers proceed from the divarications of the stem; the petals are entire. It grows in corn fields, and flowers in June. 5. *Noctiflora*, night-flowering catchfly. The stem is about two feet high, and forked; the calyx has ten angles, is somewhat clammy, and oval, with longer teeth than the other species; the petals are of a reddish white. 6. *Armeria*, broad-leaved catchfly. The stem is about 18 inches high, and erect, with few branches; the leaves are smooth, sessile, and broad at the base; the flowers terminal, in fastigiate bundles, small, and red. It may be seen on the banks of rivers, and is in flower in July and August. 7. *Acaulis*, moss campion. The radical leaves are spread on the ground like a tuft of moss; the stalks are about an inch long, and naked, bearing each a single purple flower. This last species grows on mountains, and has been found, in Wales and Scotland, within half a mile from their top. It is in flower in July.

SILESIA, a duchy of Germany, bounded on the east by Poland; on the west, by Bohemia and Lower Lusatia; on the south, by a chain of mountains, and a thicket of considerable extent which separates it from Hungary; and to the north, by the marquisate of Brandenburg and Poland. From north-west to south-east it is about 274 miles, and about 100 where broadest: but it is much contracted at both ends. Upon the frontiers of this country, to the west and south, are very high mountains, and some likewise in other parts of it. One of the ridges upon the frontiers is styled the *Riphæan Mountains*, another the *Moravian*, another the *Bohemian*, and another the *Hungarian*, *Crapack*, or *Carpathian*.

Silesia. *pathian.* A branch of the Bohemian is called the *Giant Mountains.* The winter on these hilly tracks is more severe, sets in sooner, and lasts longer, than in the low lands. The inhabitants use a kind of skates when the snow is deep, as they do in Carniola. Little or no grain is raised in the mountains and some sandy tracks; but the rest of the country is abundantly fruitful, not only in grain, but fruits, roots, pasture, flax, hops, madder, tobacco, and hemp, yielding also some wine, with considerable quantities of silk and honey. In many places are great woods of pines, fir, beech, larch, and other trees, affording tar, pitch, rosin, turpentine, lampblack, and timber for all uses. In this country also is found marble of several sorts, some precious stones, limestone, millstone, pitcoal, turf, vitriol, some silver ore, copper, lead, iron, and mineral springs. Great numbers of black cattle and horses are brought hither from Poland and Hungary for sale, those bred in the country not being sufficient; but of sheep, goats, game, and venison, they have great plenty. As for wild beasts, here are lynxes, foxes, weasels, otters, and beavers. The rivers, lakes, and ponds, yield fish of several sorts, particularly sturgeons several ells in length, and salmon. Besides a number of smaller streams to water this country, there is the Oder, which traverses it almost from one end to the other; and the Vistula, which after a pretty long course through it enters Poland. The number of the cities and market-towns is said to be about 200, the county of Glatz included, and that of the villages 5000. The inhabitants, who are computed to be about a million and an half, are a mixture of Germans, Poles, and Moravians. The language generally spoken is German; but in some places the vulgar tongue is a dialect of the Sclavonic. The states consist of the princes and dukes, and those called *state-lords*, with the nobility, who are immediately subject to the sovereign, and the representatives of the chief cities; but since the country fell under the dominion of the king of Prussia, no diets have been held. The king, however, when he took possession of the country, confirmed all the other privileges of the inhabitants. With respect to religion, not only Protestants, but Papists, Jews, and Greeks, enjoy full liberty of conscience. The greatest part of Silesia lies in the diocese of Breslaw, but some part of it in the Polish dioceses of Posen and Cracow. The bishop of Breslaw stands immediately under the pope with regard to spirituals; but all ecclesiastical benefices, not excepting the see of Breslaw, is in the king's gift. Besides Latin schools, colleges, and seminaries, at Breslaw is an university, and at Lignitz an academy for martial exercises. The principal manufactures here are woollens, linens, and cottons of several sorts, with hats, glassware, gunpowder, and iron manufactures. Of these there is a considerable exportation. Accounts are generally kept in rix-dollars, silver groschens, and ducats. With respect to its revolutions and present government, it was long a part of the kingdom of Poland; afterwards it had several dukes and petty princes for its sovereigns, who by degrees became subject to the kings of Bohemia, until at last king Charles IV. incorporated the whole duchy with Bohemia; and thus it continued in the possession of the house of Austria, until the king of Prussia in 1742, taking advantage of the troubles that ensued upon the death of the emperor Charles VI. and pretending a kind of claim, wrested a great part of it, together with the county of Glatz, from his daughter and heiress Maria Theresa, the late empress-dowager; so that now only a small part of it is possessed by the house of Austria, and connected with the empire, the rest being governed by the king of Prussia, without acknowledging any sort of dependence on the crown of Bohemia or the empire. For the administration of justice in all civil, criminal, and feudal cases, and such as relate to the revenue, the king of Prussia has established three supreme judicatories, to which an appeal lies from all the inferior ones, and from which, when the sum exceeds 500 rix-dollars, causes may be moved to Berlin. The Lutheran churches and schools are under the inspection of the upper consistories, and those of the Papists under that of the bishop's court at Breslaw; but from both an appeal lies to the tribunal at Berlin. As to the revenue, the excise here is levied only in the walled towns, being on the same footing as in the marquisate of Brandenburg; but in the rest of the country the contributions are fixed, and the same both in peace and war. The several branches of the revenue are under the management of the war and domain offices of Breslaw and Glogau. The whole revenue arising to the king of Prussia from Silesia and the county of Glatz amounts to about four millions of rix-dollars *per annum*.

Silesia || Silicernium.

Silesia is divided into Upper and Lower, and each of these again into principalities and lordships; of some of which both the property and jurisdiction belong immediately to the sovereign, but of others to his subjects and vassals. In regard to the character of the people, the boors are accounted very dull and stupid; but of those of a higher rank, many have distinguished themselves by their wit and learning, as well as by their military and political talents. However, in general, like their neighbours the Germans and Bohemians, they have more of Mars than Mercury in their composition, and their parts are more solid than shining.

SILESIAN EARTH, in the materia medica, a fine astringent bole. It is very heavy, of a firm compact texture, and in colour of a brownish yellow. It breaks easily between the fingers, and does not stain the hands; is naturally of a smooth surface, is readily diffusible in water, and melts freely into a butter-like substance in the mouth. It leaves no grittiness between the teeth, and does not ferment with acid menstrua. It is found in the perpendicular fissures of rocks near the gold-mines at Strigonium in Hungary, and is supposed to be impregnated with the sulphur of that metal. It is a good astringent, and better than most of the boles in use.

SILICERNIUM, among the Romans, was a feast of a private nature, provided for the dead some time after the funeral. It consisted of beans, lettuces, bread, eggs, &c. These were laid upon the tomb, and they foolishly believed that the dead would come out for the repast. What was left was generally burnt on the stone. The word *silicernium* is derived from *silex* and *cœna*, i. e "a supper upon a stone." Eating what had thus been provided for the dead, was esteemed a mark of the most miserable poverty. A similar entertainment was made by the Greeks at the tombs of the deceased; but it was usual among them to treat the ghosts with the fragments from the feast of the living. See FUNERAL and INFERIÆ.

Silex
||
Silius.

SILEX. See FLINT.

SILICEOUS EARTHS. See MINERALOGY, Part II. Order 4.

SILIUS (Italicus Caius), an ancient Roman poet, and author of an epic poem in 17 books, which contains an hiſtory of the ſecond Punic war, ſo famous for having decided the empire of the world in favour of the Romans. He was born in the reign of Tiberius, and is ſuppoſed to have derived the name of *Italicus* from the place of his birth; but whether he was born at Italica in Spain, or at Corſinium in Italy, which, according to Strabo, had the name of *Italica* given it during the Social war, is a point which cannot be known: though, if his birth had happened at either of theſe places, the grammarians would tell us, that he ſhould have been called *Italicenſis*, and not *Italicus*. When he came to Rome, he applied himſelf to the bar; and, by a cloſe imitation of Cicero, ſucceeded ſo well, that he became a celebrated advocate and moſt accompliſhed orator. His merit and character recommended him to the higheſt offices in the republic, even to the conſulſhip, of which he was poſſeſſed when Nero died. He is ſaid to have been aiding and aſſiſting in accuſing perſons of high rank and fortune, whom that wicked emperor had devoted to deſtruction: but he retrieved his character afterwards by a long and uniform courſe of virtuous behaviour. Veſpaſian ſent him as proconſul into Aſia, where he behaved with clean hands and unblemiſhed reputation. After having thus ſpent the beſt part of his life in the ſervice of his country, he bade adieu to public affairs, reſolving to conſecrate the remainder to polite retirement and the muſes. He had ſeveral fine villas in the country: one at Tuſculum, celebrated for having been Cicero's; and a farm near Naples ſaid to have been Virgil's, at which was his tomb, which Silius often viſited. Thus Martial compliments him on both theſe accounts:

Silius hæc magni celebrat monumenta Maronis,
Jugera facundi qui Ciceronis habet.
Hæredem Dominumque ſui tumulique lariſque
Non alium mallet nec Maro nec Cicero.

Epigr. 49. lib. xi.

Of Tully's ſeat my Silius is poſſeſs'd,
And his the tomb where Virgil's aſhes reſt.
Could thoſe great ſhades return to chooſe their heir,
The preſent owner they would both prefer.

In theſe retirements he applied himſelf to poetry: led not ſo much by any great force of genius, which would certainly not have ſuffered him to ſtay till life was in the wane and his imagination growing cold, as by his exceeding great love of Virgil, to whoſe memory he paid the higheſt veneration. He has imitated him in his poem; and though he falls infinitely ſhort of him, yet he has diſcovered a great and univerſal genius, which would have enabled him to ſucceed in ſome degree in whatever he undertook.

Having been for ſome time afflicted with an impoſthume, which was deemed incurable, he grew weary of life, to which, in the language of Pliny, he put an end with determined courage.

There have been many editions of Silius Italicus. A neat and correct one was publiſhed at Leipſic in 1696, in 8vo, with ſhort and uſeful notes by Cellarius: but the beſt is that *cum notis integris variorum et Arnoldi Drakenborch.* Traject. ad Rhen. 1717, in 4to.

Silk.

SILK, a very ſoft, fine, bright thread, the work of an inſect called *bombyx*, or the ſilk worm.

As the ſilk worm is a native of China, the culture of ſilk in ancient times was entirely confined to that country. We are told that the empreſſes, ſurrounded by their women, ſpent their leiſure hours in hatching and rearing ſilk worms, and in weaving tiſſues and ſilk veils. That this example was ſoon imitated by perſons of all ranks, we have reaſon to conclude; for we are informed that the Chineſe, who were formerly clothed in ſkins, in a ſhort time after were dreſſed in veſtments of ſilk. Till the reign of Juſtinian, the ſilk worm was unknown beyond the territories of China, but ſilk was introduced into Perſia long before that period. After the conqueſt of the Perſian empire by Alexander the Great, this valuable commodity was brought into Greece, and thence conveyed to Rome. The firſt of the Roman writers extant by whom ſilk is mentioned, are Virgil and Horace; but it is probable that neither of them knew from what country it was obtained, nor how it was produced. By ſome of the ancients it was ſuppoſed to be a fine down adhering to the leaves of certain trees or flowers. Others imagined it to be a delicate ſpecies of wool or cotton; and even thoſe who had learned that it was the work of an inſect, ſhow by their deſcriptions that they had no diſtinct idea of the manner in which it was formed. Among the Romans, ſilk was deemed a dreſs too expenſive and too delicate for men, and was appropriated wholly to women of eminent rank and opulence. Elagabulus is ſaid to have been the firſt man amoug the Romans who wore a garment of fine ſilk: Aurelian complained that a pound of ſilk was ſold at Rome for 12 ounces of gold; and it is ſaid he refuſed to give his wife permiſſion to wear it on account of its exorbitant price.

1 Opinions of the ancients concerning the nature of ſilk.

For ſeveral centuries the Perſians ſupplied the Roman empire with the ſilks of China. Caravans traverſed the whole latitude of Aſia, in 243 days, from the Chineſe ocean to the ſea-coaſt of Syria, carrying this commodity. Sometimes it was conveyed to the ports of Guzerat and Malabar, and thence tranſported by ſea to the Perſian Gulph. The Perſians, with the uſual rapacity of monopoliſts, raiſed the price of ſilk to ſuch an exorbitant height, that Juſtinian, eager not only to obtain a full and certain ſupply of a commodity which was become of indiſpenſable uſe, but ſolicitous to deliver the commerce of his ſubjects from the exactions of his enemies, endeavoured, by means of his ally, the Chriſtian monarch of Abyſſinia, to wreſt ſome portion of the ſilk trade from the Perſians. In this attempt he failed; but when he leaſt expected it, he, by an unforeſeen event, attained, in ſome meaſure, the object which he had in view. Two Perſian monks having been employed as miſſionaries in ſome of the Chriſtian churches, which were eſtabliſhed (as we are informed by Coſmas) in different parts of India, had penetrated into the country of the Seres, or China. There they obſerved the labours of the ſilk worm, and became acquainted with all the arts of man in working up its productions into ſuch a variety of elegant fabrics. The proſpect of gain, or perhaps an indignant zeal, excited by ſeeing this lucrative branch of commerce engroſſed by unbelieving

2 Brought from China by the Perſians till the time of Juſtinian.

Robertſon's Diſquiſition concerning India, p. 88.

3 Silk worms introduced into Europe by two monks.

nations,

Silk. nations, prompted them to repair to Conſtantinople. There they explained to the emperor the origin of ſilk, as well as the various modes of preparing and manufacturing it, myſteries hitherto unknown, or very imperfectly underſtood in Europe; and encouraged by his liberal promiſes, they undertook to bring to the capital a ſufficient number of thoſe wonderful inſects, to whoſe labours man is ſo much indebted. This they accompliſhed, by conveying the eggs of the ſilk worm in a hollow cane. They were hatched by the heat of a dunghill, fed with the leaves of a wild mulberry tree, and they multiplied and worked in the ſame manner as in thoſe climates where they firſt became objects of human attention and care. Vaſt numbers of theſe inſects were ſoon reared in different parts of Greece, particularly in the Peloponneſus. Sicily afterwards undertook to breed ſilk worms with equal ſucceſs, and was imitated, from time to time, in ſeveral towns of Italy. In all theſe places extenſive manufactures were eſtabliſhed and carried on with ſilk of domeſtic production. The demand for ſilk from the eaſt diminiſhed of courſe, the ſubjects of the Greek emperors were no longer obliged to have recourſe to the Perſians for a ſupply of it, and a conſiderable change took place in the nature of the commercial intercourſe between Europe and India.

As ſilk is the production of a worm, it will be firſt neceſſary to give a deſcription of its nature and mode of manufacturing. But before we give any account of the moſt approved methods of managing ſilk worms in Europe, it will be proper to preſent a ſhort deſcription of the methods practiſed in China, the original country of the ſilk worm. Theſe are two: they either permit them to remain at liberty on mulberry trees, or keep them in rooms. As the fineſt ſilk is produced by worms confined in rooms, and as the firſt method is very ſimple, it will ſuffice to deſcribe the ſecond.

Payne's Geography

4 Method of rearing ſilk worms in China.

To begin with the eggs, which are laid on large ſheets of paper, to which they firmly adhere. The ſheets are hung up on a beam of the room, with the eggs inward, and the windows are opened in the front to admit the wind; but no hempen ropes muſt ever come near the worms or their eggs. After ſome days the ſheets are taken down, rolled up looſely with the eggs inward, and then hung up again, during the ſummer and autumn. At the end of December, or the beginning of January, the eggs are put into cold water, with a little ſalt diſſolved in it. Two days after they take them out, hang them up again, and when dry roll them a little tighter, and encloſe each ſeparately, ſtanding on one end in an earthen veſſel. Some put them into a lye made of mulberry tree aſhes, and then lay them ſome moments in ſnow-water, or elſe hang them up three nights on a mulberry tree to receive the ſnow or rain, if not too violent. The time of hatching them is when the leaves of the mulberry trees begin to open, for they are haſtened or impeded according to the different degrees of heat or cold to which they are expoſed. When they are ready to come forth, the eggs ſwell, and become a little pointed.

The third day before they are hatched, the rolls of paper are taken out of the veſſel, ſtretched out, and hung up with their backs toward the ſun, till they receive a kindly warmth; and then being rolled up cloſe, they are ſet upright in a veſſel in a warm place. This is repeated the next day, and the eggs change to an aſh-grey. They then put two ſheets together, and rolling them cloſe tie the ends. Silk.

The third day, towards night, the ſheets are unrolled and ſtretched on a fine mat, when the eggs appear blackiſh. They then roll three ſheets together, and carry them into a pretty warm place, ſheltered from the ſouth wind. The next day the people taking out the rolls, and opening them, find them full of worms like ſmall black ants.

The apartment choſen for ſilk worms is on a dry ground, in a pure air, and free from noiſe. The rooms are ſquare, and very cloſe, for the ſake of warmth; the door faces the ſouth, and is covered with a double mat, to keep out the cold; yet there ſhould be a window on every ſide, that when it is thought neceſſary the air may have a free paſſage. In opening a window to let in a refreſhing breeze, care muſt be taken to keep out the gnats and flies. The room muſt be furniſhed with nine or ten rows of frames, about nine inches one above the other. On theſe they place ruſh hurdles, upon which the worms are fed till they are ready to ſpin; and, to preſerve a regular heat, ſtove fires are placed at the corners of the room, or elſe a warming pan is carried up and down it; but it muſt not have the leaſt flame or ſmoke. Cow-dung dried in the ſun is eſteemed the moſt proper fuel.

The worms eat equally day and night. The Chineſe give them on the firſt day forty-eight meals: that is, one every half hour; the next thirty; the third day they have ſtill leſs. As cloudy and rainy weather takes away their ſtomach, juſt before their repaſt a wiſp of very dry ſtraw, the flame of which muſt be all alike, is held over the worms to free them from the cold and moiſture that benumbs them, or elſe the blinds are taken from the windows to let in the full day-light.

Eating ſo often haſtens their growth, on which the chief profit of the ſilk worm depends. If they come to maturity in 23 or 25 days, a large ſheet of paper covered with worms, which at their firſt coming from the eggs weigh little more than a drachm, will produce 25 ounces of ſilk; but if not till 28 days, they then yield only 20 ounces; and if they are a month or 40 days in growing, they then produce but ten.

They are kept extremely clean, and are often removed; and when they are pretty well grown, the worms belonging to one hurdle are divided into three, afterwards they are placed on ſix, and ſo on to the number of 20 or more; for being full of humours, they muſt be kept at a due diſtance from each other. The critical moment for removing them is when they are of a bright yellow and ready to ſpin; they muſt be ſurrounded with mats at a ſmall diſtance, which muſt cover the top of the place to keep off the outward air; and becauſe they love to work in the dark. However, after the third day's labour, the mats are taken away from one o'clock till three, but the rays of the ſun muſt not ſhine upon them. They are at this time covered with the ſheets of paper that were uſed on the hurdles.

The cocoons are completed in ſeven days, after which the worm is metamorphoſed into a chryſalis; the cocoons are then gathered, and laid in heaps, having firſt ſet apart thoſe deſigned for propagation upon a hurdle, in a cool airy place. The next care is to kill the moths in thoſe cones which are not to be bored. The beſt way of doing this is to fill large earthen veſſels with cones

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cones in layers of ten pounds each, throwing in four ounces of ſalt with every layer, and covering it with large dry leaves like thoſe of the water-lily, and cloſely ſtopping the mouth of the veſſels. But in laying the cones into the veſſels, they ſeparate the long, white, and glittering ones, which yield a very fine ſilk, from thoſe that are thick, dark, and of the colour of the ſkin of an onion, which produce a coarſer ſilk.

5 Deſcription and hiſtory of the ſilk worm.

The ſilk worm is a ſpecies of caterpillar, which, like all others of the ſame claſs, undergoes a variety of changes, that, to perſons who are not acquainted with objects of this kind, will appear to be not a little ſurpriſing.

The Bee, n° 72.

It is produced from a yellowiſh coloured egg, about the ſize of a ſmall pin head, which has been laid by a kind of greyiſh coloured moth, which the vulgar confound with the butterfly.

Theſe eggs, in the temperature of this climate, if kept beyond the reach of the fire and ſun ſhine, may be preſerved during the whole of the winter and ſpring months without danger of hatching: and even in ſummer they may eaſily be prevented from hatching if they be kept in a cool place; but in warmer climates it is ſcarcely poſſible to preſerve them from hatching, even for a few days, or from drying ſo much as to deſtroy them. Hence it is eaſy for a native of Britain to keep the eggs till the food on which the worm is to feed be ready for that purpoſe. When this food is in perfection, the eggs need only be expoſed to the ſun for a day or two, when they will be hatched with great facility.

When the animal is firſt protruded from the egg, it is a ſmall black worm, which is active, and naturally aſcends to the top of the heap in ſearch of food. At this ſtage of his growth the ſilk worm requires to be fed with the youngeſt and moſt tender leaves. On theſe leaves, if good, he will feed very freely for about eight days, during which period he increaſes in ſize to about a quarter of an inch in length. He is then attacked with his firſt ſickneſs, which conſiſts in a kind of lethargic ſleep for about three days continuance; during which time he refuſes to eat, and changes his ſkin, preſerving the ſame bulk. This ſleep being over, he begins to eat again, during five days, at which term he is grown to the ſize of full half an inch in length; after which follows a ſecond ſickneſs in every reſpect like the former.

He then feeds for other five days; during which time he will have increaſed to about three quarters of an inch in length, when he is attacked with his third ſickneſs. This being over, he begins to eat again, and continues to do ſo for five days more, when he is attacked by his fourth ſickneſs, at which time he is arrived at his full growth. When he recovers this ſickneſs, he feeds once more during five days with a moſt voracious appetite; after which he diſdains his food, becomes tranſparent, a little on the yellowiſh caſt, and leaves his ſilky traces on the leaves where he paſſes. Theſe ſigns denote that he is ready to begin his cocoon, and will eat no more.

Thus it appears that the whole duration of the life of the worm, in this ſtate of its exiſtence, in our climate, is uſually about 46 days; 28 of which days he takes food, and remains in his ſick or torpid ſtate 18; but it is to be obſerved, that during warm weather the periods of ſickneſs are ſhortened, and in cold weather lengthened, above the terms here ſpecified. In very hot climates it may be ſaid to live faſter, and ſooner to attain maturity, than in thoſe that are colder. Dr Anderſon informs us, that at Madras the worm undergoes its whole evolutions in the ſpace of 22 days. It appears, however, that it feeds fully as many days in India as in Europe, the difference being entirely occaſioned by ſhortening the period of ſickneſs. The longeſt ſickneſs he had ſeen them experience there did not exceed two days; and during ſummer it only laſts a few hours.

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When the worm has attained its full growth, it ſearches about for a convenient place for forming its cocoon, and mounts upon any branches or twigs that are put in its way for that purpoſe. After about two days ſpent in this manner, it ſettles in its place, and forms the cocoon, by winding the ſilk which it draws from its bowels round itſelf into an oblong roundiſh ball.

During this operation it gradually loſes the appearance of a worm; its length is much contracted, and its thickneſs augmented. By the time the web is finiſhed, it is found to be transformed into an oblong roundiſh ball, covered with a ſmooth ſhelly ſkin, and appears to be perfectly dead. In this ſtate of exiſtence it is called an *aurelia*. Many animals in this ſtate may be often ſeen ſticking on the walls of out-houſes, ſomewhat reſembling a ſmall bean.

In this ſtate it remains for ſeveral days entirely motionleſs in the heart of the cocoon, after which it burſts like an egg hatching, and from that comes forth a heavy dull looking moth with wings; but theſe wings it never uſes for flying; it only crawls ſlowly about in the place it has been hatched. This creature forces its way through the ſilk covering which the worm had woven, goes immediately in queſt of its mate, after which the female lays her eggs; and both male and female, without taſting food in this ſtage of their exiſtence, die in a very ſhort time.

The ſilk worm, when at its full ſize, is from an inch and a quarter to an inch and a half in length, and about half an inch in circumference. He is either of a milk or pearl colour, or blackiſh; theſe laſt are eſteemed the beſt. His body is divided into ſeven rings, to each of which are joined two very ſhort feet. He has a ſmall point like a thorn exactly above the anus. The ſubſtance which forms the ſilk is in his ſtomach, which is very long, wound up, as it were, upon two ſpindles, as ſome ſay, and ſurrounded with a gum, commonly yellowiſh, ſometimes white, but ſeldom greeniſh. When the worm ſpins his cocoon, he winds off a thread from each of his ſpindles, and joins them afterwards by means of two hooks which are placed in his mouth, ſo that the cocoon is formed of a double thread. Having opened a ſilk worm, you may take out the ſpindles, which are folded up in three plaits, and, on ſtretching them out, and drawing each extremity, you may extend them to near two ells in length. If you then ſcrape the thread ſo ſtretched out with your nail, you ſcrape off the gum, which is very like bees wax, and performs the ſame office to the ſilk it covers as gold leaf does to the ingot of ſilver it ſurrounds, when drawn out by the wire drawer. This thread, which is extremely ſtrong and even, is about the thickneſs of a middling pin.

6 Particular attention ought to be paid to the breed of ſilk worms.

Of ſilk worms, as of moſt other animals, there is a conſiderable variety of breeds, ſome of which are much more hardy, and poſſeſs qualities conſiderably different from others. This is a particular of much importance to

Silk. to be adverted to at the time of beginning to breed these creatures in any place; for it will make a great difference in the profit on the whole to the undertaker if he rears a good or a bad ſort(A). This is a department in reſpect to the economy of animals that has been in every caſe much leſs adverted to than it deſerves; and in particular with regard to the ſilk worm it has been almoſt entirely overlooked. A few eggs of the ſilk worm can be eaſily tranſported by poſt in a letter from any part of Europe to another, eſpecially during the winter ſeaſon. It would therefore be an eaſy matter for any patriotic ſociety, ſuch as the Society of Arts in London, to obtain a ſpecimen of the eggs from every country in which ſilk is now reared, to put theſe under the care of a perſon who could be depended upon, and who underſtood the management of them, with orders to keep each kind diſtinct from another, and advert to every particular that occurred in their management, ſo as to make a fair eſtimate of their reſpective merits. By theſe means the beſt might be ſelected, and thoſe of inferior value rejected. Forty or fifty of each ſort might be enough for the experiment; but it ought to be repeated ſeveral times before concluſions could be drawn from it that might be altogether relied upon; for it is well known that a variation of circumſtances will make a change in the reſult; and it is by no means certain that the ſame particular would affect thoſe of one breed exactly in the ſame manner as it would do thoſe of a different breed. One may be more hardy with regard to cold, another more delicate in reſpect to food, and ſo on. It is experience alone that can aſcertain the circumſtances here inquired for.

7 The management of ſilk worms muſt be different in different climates; From the above-mentioned particulars, it is evident, that the management of ſilk worms muſt be very different in hot climates from what is required in thoſe that are colder. At Madras, it appears from Dr Anderſon's experiments that it is very difficult to prevent the eggs from hatching for a very few days, ſo that many generations of them muſt be propagated in one year. "In this hotteſt ſeaſon," ſays he, in a letter to Sir Joſeph Banks, dated July 6. 1791, "the ſhorteſt time I have been able to remark for the whole evolutions of the ſilk worm is 40 days; that is to ſay, ſix days an egg, 22 a worm, 11 a grub in the cocoon, and one a moth or butterfly." Fortunately, where the climate forces forward their production ſo rapidly, nature hath been equally provident of food for their ſubſiſtence; for in theſe regions the mulberry continues to grow and puſh out leaves throughout the whole year.

8 But may be eaſily reared in temperate climes. Though the ſilk worm be a native of China, there is no doubt but it might eaſily be propagated perhaps in moſt parts of the temperate zones. The eggs of this inſect, indeed, require a conſiderable degree of warmth to hatch them, but they can alſo endure a ſevere froſt. No leſs than 5400 lbs of ſilk was raiſed in 1789 in the cold, ſandy territories of Pruſſia. In the province of Pekin, in China, where great quantities of ſilk are fabricated, the winter is much colder than even in Scotland. From the information of ſome Ruſſians who were ſent thither to learn the Chineſe language, we find that Reaumur's thermometer was obſerved from 10 to 15, and even 20 degrees below the freezing point. Nor is it difficult to rear the food of the ſilk worm in a temperate clime. The mulberry-tree is a hardy vegetable, which bears, without injury, the winters of Sweden, and even of Siberia. Of the ſeven ſpecies of the mulberry (ſee MORUS) enumerated by Linnæus, four of theſe (viz. the white, red, black, and Tartarian), there is every reaſon to believe could be reared both in Britain and Ireland. The *white* grows in Sweden; the *red* is abundant round Quebec; the *black* delights in bleak ſituations, expoſed to wind on the ſea ſhore; and the *Tartarian* mulberry is repreſented as growing in the chilly regions of Siberia. Silk. *Bee*, N° 156.

9 Whether any ſpecies of mulberry-tree be ſuperior to others. As to the ſuperior qualities of the different ſpecies, probably there is very little to be pointed out amongſt the four juſt mentioned with regard to nouriſhment, except what may be drawn from the following fact: that if the firſt three are laid down together, the ſilk worm will firſt eat the white, then the red, and next the black, in the order of the tenderneſs of the leaves. The Tartarian ſeems to hold as high a place in its eſteem as either the red or black; but all muſt yield to the white, which ſeems to be its natural food.

In Calabria the red mulberry is uſed; in Valencia the white; and in Granada, where excellent ſilk is produced, the mulberries are all black. The white ſeems to proſper very well in a moiſt ſtiff ſoil: the black agrees well with a dry, ſandy, or gravelly ſoil; and the white is moſt luxuriant in a moiſt rich loam.

10 Britain poſſeſſes ſome advantages over warmer countries for raiſing ſilk. It may juſtly be aſſerted, that Britain poſſeſſes ſome advantages in the raiſing of raw ſilk which are not enjoyed by warmer countries. Even in the ſouth of France, Mr Arthur Young informs us, the mulberry leaves are often nipped by froſt in the bud; but this is ſcarcely ever the caſe with us. It is well known that thunder and lightning are hurtful to the ſilk worm. Now our climate can boaſt that it is almoſt wholly exempted from thoſe dreadful ſtorms of thunder and lightning which prevail ſo much in hot climates. Nature has then furniſhed us with every thing requiſite for the ſilk manufacture; it remains only for us to improve the advantages which we poſſeſs. Let mulberry trees be planted by proprietors of lands, and let a few perſons

(A) As the ſucceſs of the ſilk manufacture muſt depend on the breed of worms, it is of great conſequence to bring them from thoſe countries where they are reckoned beſt.

Mr Andrew Wright, an ingenious ſilk manufacturer of Paiſley, has given the following directions for conveying the eggs of the ſilk worm from diſtant countries by ſea: As ſoon as the moth has laid her eggs, dry them immediately, and put them into glaſs vials; ſeal them ſo cloſe that damp air or water will not penetrate into them. Put theſe phials that contain the eggs into earthen pots filled with cold water; and as often as the water becomes warm renew it. Place the earthen veſſels in the coldeſt place of the ſhip, and let them remain until the end of the voyage. It muſt be obſerved, that the ſhip choſen for this purpoſe ought to be one that would arrive in Britain in the months of June or July.

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of ſkill and attention devote their time to the raiſing of ſilk worms. This is an employment that will not interfere with any manufacture already eſtabliſhed; on the contrary, it would afford a reſpectable, a lucrative, and agreeable employment to ladies, or to females in general, who have at preſent too few profeſſions to which they can apply. The ſociety inſtituted at London for the encouragement of arts, manufactures, and commerce, much to their honour, have offered premiums to thoſe who ſhall plant a certain number of mulberry trees.

11 Method of raiſing mulberry-trees in the ſouth of France.

The following method of raiſing mulberry trees from ſeed is practiſed in the ſouth of France, and has been repeated with ſucceſs in the Eaſt Indies by Dr Anderſon of Madras. "Take the ripe berries of the mulberry when it is full of juice and of ſeeds. Next take a rough horſe hair line or rope, ſuch as we dry linen on, and with a good handful of ripe mulberries run your hand along the line, bruiſing the berries and maſhing them as much as poſſible as your hand runs along, ſo that the pulp and ſeeds of the berries may adhere in great abundance to the rope or hair line. Next dig a trench in the ground where you wiſh to plant them, much like what is practiſed in kitchen gardens in England for crops of various kinds. Next cut the rope or hair line into lengths according to the length of the trench you think fit to make, and plunge the line full of maſhed berries into the trench, and then cover it over well with earth, always remembering afterwards to water it well, which is eſſential to the ſucceſs. The ſeeds of the berries thus ſown will grow, and ſoon ſhoot out young ſuckers, which will bear young leaves, which are the beſt food for the ſilk worm.

Letters on the Culture of Raw Silk on the Coaſt of Coromandel.

"The facility and rapidity with which young leaves may by this means be produced is evident, for as many rows of trenches may thus be filled as can be wiſhed; and it can never be neceſſary to have mulberry trees higher than our raſpberries, currants, or gooſeberry buſhes. Whenever they get beyond that, they loſe their value; and if theſe trenches ſucceed, you may have a ſupply coming freſh up day after day, or any quantity you pleaſe." Thus abundance of theſe trees might be reared. But as mulberry trees are not yet found in abundance in this country, it were to be wiſhed that ſome other food could be ſubſtituted in their place: attempts have accordingly been made by thoſe who have reared ſilk worms, and it has been found poſſible to ſupport the ſilk worm upon lettuce (B).

Bee, N° 70.

12 Miſs Rhodes fed ſilk worms on lettuce for ſome time.

Miſs Henrietta Rhodes, a lady who has made ſome ſucceſsful experiments on raiſing ſilk worms in England, had found that the ſilk worm could with ſafety be kept on lettuce for ſome time. This is pretty generally known by ladies who have turned their attention to this ſubject; but ſhe found that in general they could not with ſafety be kept upon that food above three weeks. If longer fed upon that plant, the worms for the moſt part die without ſpinning a web at all. She found, however, that they did not always die, but that in ſome caſes they produced very good cocoons, even when fed entirely on lettuce. She therefore with reaſon ſuſpected that the death of the animal muſt be occaſioned by ſome extraneous circumſtance, and not from the poiſonous quality of the food itſelf; the circumſtance ſhe ſuſpected, from ſome incidental obſervations, was the coldneſs of that food; and therefore ſhe thought it was not impoſſible, but if they were kept in a very warm place, while fed on lettuce, they might attain, in all caſes, a due perfection.

Silk.

13 General Mordaunt ſtill more ſucceſsful.

General Mordaunt having been informed of this conjecture, reſolved to try the experiment. He got ſome ſilk worms eggs, had them hatched in his hot-houſe, and cauſed them to be all fed upon lettuce and nothing elſe. They proſpered as well as any worms could do, few or none of them died; and they afforded as fine cocoons as if they had been fed upon mulberry leaves. As far as one experiment can go, this affords a very exhilarating proſpect in many points of view. If one kind of food has been noxious, merely on account of an improper temperature, others may be found which have been hurtful only from a ſimilar cauſe; ſo that it is not impoſſible but we may at laſt find that this delicate creature may be ſupported by a variety of kinds of food. Few, however, could be more eaſily obtained than lettuce; and this plant, when cabbaged (the coſs, or ice lettuce eſpecially), would poſſeſs one quality that the mulberry leaf never can poſſeſs, from the want of which many millions of worms die in thoſe countries where ſilk is now reared; for it is obſerved, that when the leaves are gathered wet, it is ſcarcely poſſible to preſerve the worms alive for any length of time; ſo that during a continuance of rainy weather many of them are unavoidably cut off; but a lettuce, when cabbaged, reſiſts moiſture. If gathered, even during rain, the heart of it is dry; ſo that if the outer leaves be thrown aſide at that time, the worms would be continued in perfect health. The expence, too, of cultivating and gathering lettuce, would be ſo much leſs than that of gathering mulberry leaves, as to occaſion a ſaving that would be much more than ſufficient to counterbalance the expence of heating the conſervatory, as a little reflection will ſhow.

But the great point to be now aſcertained is, whether it is a fact that worms fed on lettuce, if kept in a due temperature, will continue in good health, in general, till they ſhall have perfected their cocoon? One experiment is too little to eſtabliſh this fact with perfect certainty. It would therefore be neceſſary that more experiments ſhould be made on this ſubject.

14 Silk worms ſaid to be fed on dried mulberry leaves.

It is ſaid that Dr Lodovico Bellardi, a learned and ingenious botaniſt of Turin, has, after a number of experiments, diſcovered a new method of feeding ſilk worms, when they are hatched before the mulberry trees have produced leaves, or when it happens that the froſt deſtroys the tender branches. This new method conſiſts in giving the worms dried leaves of the mulberry-tree. One would think that this dry nouriſhment

(B) It is not improbable, ſays Dr Anderſon, to whoſe valuable work entitled the *Bee*, we have been much indebted in the drawing up of this article, that other kinds of food may be found which will anſwer the ſame purpoſe. The chicorium intybus and common endive might be tried, as they have the ſame lacteſcent quality with the lettuce.

Silk. ment would not be much reliſhed by theſe inſects; but repeated experiments made by our author, prove that they prefer it to any other, and eat it with the greateſt avidity. The mulberry leaves muſt be gathered about the end of autumn, before the froſts commence, in dry weather, and at times when the heat is greateſt. They muſt be dried afterwards in the ſun, by ſpreading them upon large cloths, and laid up in a dry place after they have been reduced to powder. When it is neceſſary to give this powder to the worms, it ſhould be gently moiſtened with a little water, and a thin coat of it muſt be placed around the young worms, which will immediately begin to feed upon it.

15 Proper experiments ought to be made on various vegetables.

We have mentioned all the different kinds of food, which, as far as we have heard, have been tried with any ſucceſs to nouriſh the ſilk worm; not, however, with great confidence, but as experiments which it might be worth while carefully to conſider and perform. We muſt not omit to mention that one perſon, who has had much experience in the managing of ſilk worms, aſſures us, that the ſilk produced from any other food than mulberry leaves is of an inferior quality, and that the worms are ſickly. We think, however, that there is reaſon to ſuſpect that the experiment has not been ſkilfully performed; and therefore, before every other food except mulberry leaves is diſcarded, the experiment ought to be performed with more attention and care. We know that many animals in a domeſtic ſtate can live upon food very different from that which ſupported them when running wild in the fields. Certain it is, however, that every animal, in its ſtate of nature, partakes of a food peculiar to itſelf, which is rejected by other animals as if it were of a poiſonous quality; and it may be mentioned as a curious fact, as well as an admirable inſtance of the care of that Being who feeds the fowls of heaven, that notwithſtanding the numberleſs inſects that prey upon animals and vegetables, the mulberry tree is left untouched by them all, as the excluſive property of the ſilk worm, the chief of the inſect tribe, which toils and ſpins for the uſe of man.

16 What ſituation and apartments proper for theſe inſects.

Having now conſidered the food proper for the ſilk worm, we ſhall next conſider what ſituation is moſt favourable to them. In the opinion of ſome perſons in this country who have been in the practice of rearing ſilk worms, they ought always to be kept in a dry place, well ſheltered, and poſſeſſing a conſiderable degree of warmth, and which is not expoſed to ſudden tranſitions from heat to cold. If the weather be too cold, a ſmall fire muſt be made: this is of moſt importance when the worms are ready for ſpinning. A ſouthern expoſure is therefore preferable. Some think light is of great utility to ſilk worms, others think that they thrive better in the dark. As to what apartments are beſt accommodated for promoting the health of ſilk worms, and moſt convenient for thoſe who have the care of them, they may be various according to the extent of the manufacture or the wealth of the proprietors. Silk worms may be kept in boxes or in ſhelves. When ſhelves are to be uſed, they may be conſtructed in the following manner: The ſhelves may be of wicker, ranged at the diſtance of a foot and a half, and fixed in the middle of the room: their breadth ought to be ſuch, that any perſon can eaſily reach to the middle from either ſide. This is perhaps the ſimpleſt and cheapeſt apparatus for rearing ſilk worms; but there is another apparatus which may be recommended to thoſe who are anxious to unite ſome degree of elegance with convenience. This apparatus is the invention of the Rev. George Swayne of Puckle-church, a gentleman who, greatly to his honour, has ſtudied this ſubject much, in order to find out the way for promoting the culture of ſilk among the poor. This apparatus, with the deſcription of it, we have borrowed from that valuable and patriotic work, the Tranſactions of the Society for encouraging Arts, Manufactures, and Commerce, Vol. VII. p. 148. The apparatus conſiſts of a wooden frame four feet two inches high, each ſide 16 inches and a half wide, divided into eight partitions by ſmall pieces of wood which form grooves, into which the ſlides run, and are thus eaſily thruſt into or drawn out of the frame. The upper ſlide (*a*) in the model ſent to the ſociety by Mr Swayne is of paper only, and deſigned to receive the worms as ſoon as hatched; the two next (*b*, *b*) are of catgut, the threads about one-tenth of an inch diſtant from each other: theſe are for the inſects when a little advanced in ſize: the five lower ones, marked *c*, *c*, *c*, *c*, *c*, are of wicker work; but, as Mr Swayne afterwards found, netting may be ſubſtituted with advantage inſtead of wicker bottoms. Under each of theſe, as well as under thoſe of catgut, are ſliders made of paper, to prevent the dung of the worms from falling on thoſe feeding below them.

Silk.

17 Mr Swayne's apparatus deſcribed.

Plate CCCCLXVI.

18 Proper time for hatching ſilk worms.

The management of ſilk worms is next to be attended to. The proper time for hatching them is when the leaves of the mulberry are full grown, or nearly ſo; that as ſoon as theſe inſects are capable of receiving food they may obtain it in abundance. To attempt to hatch them ſooner would be hurtful, as the weather would not be ſufficiently warm. Beſides, as leaves are neceſſary to the life of a vegetable, if the young leaves of the mulberry-tree are cropped as ſoon as they are unfolded, the tree will be ſo much weakened as to be incapable of producing ſo many leaves as it would otherwiſe have done; and if this practice be frequently repeated, will inevitably be deſtroyed.

19 How they ought to be hatched and fed.

When the proper ſeaſon is arrived, the eggs may be hatched either by the heat of the ſun, when it happens to be ſtrong enough, or by placing them in a ſmall room moderately heated by a ſtove or fire; and after being expoſed for ſix or ſeven days to a gentle heat, the ſilk worm iſſues from the egg in the form of a ſmall black hairy caterpillar. When Mr Swayne's apparatus is uſed, the worms are to be kept on the drawers with paper bottoms till they are grown ſo large as not readily to creep through the gauze-bottomed drawers: they are then to be placed on thoſe drawers, where they are to remain till their excrements are ſo large as not readily to fall through; when this is the caſe, they muſt be removed to the drawers with the wicker or netting bottoms, and fed thereon till they ſhow ſymptoms of being about to ſpin. It is ſcarcely neceſſary to mention, that the paper ſlides beneath the gauze and wicker drawers are intended to receive the dung, which ſhould be emptied as often as the worms are fed, at leaſt once a-day; or to direct, that when the worms are fed, the ſlides are to be firſt drawn out a conſiderable way, and the drawers to reſt upon them.

20 Wet or damp food produces contagious diſeaſes.

It has been already mentioned, that wet or damp food is exceedingly prejudicial to theſe inſects. It produces contagious and fatal diſeaſes. To prevent the neceſſity of giving them wet or damp food, attention

Silk. ought to be paid to the weather, ſo that when there is an immediate proſpect of rain, a ſufficient quantity of leaves may be gathered to ſerve the worms two or three days. In this country, the leaves of the black or red mulberry tree may be preſerved good for food, although kept four or five days, by the following method: When new gathered, lay them looſely in glazed earthen veſſels, place theſe in a cold place, well aired, not expoſed to drought.

21 Ought to be kept as clean as poſſible.

The utmoſt attention muſt be paid to preſerve the place where ſilk worms are kept as clean as poſſible: the houſe or room muſt be well ventilated, that no noxious vapours be accumulated. By ſome experiments of M. Faujas de St Fond, which are recorded in his hiſtory of Languedoc, it appears that the ſilk worm is much injured by foul air. All decayed leaves muſt be removed from them, as it is now well known that they emit bad air in great abundance.

One of the moſt difficult branches of the management of ſilk worms has hitherto been the cleaning without bruiſing them. To avoid this inconvenience, the peaſants in France and Italy frequently allow the whole litter to remain without ever cleaning them, which is the cauſe of that unwholeſome ſtench that has been ſo often remarked by thoſe who viſit the places for rearing ſilk worms in theſe countries. This difficulty may be effectually removed by providing a net, or, what would be ſtill better, a wire-bottomed frame, wrought into large meſhes like a riddle. Have that made of a ſize exactly ſufficient to cover the wooden box in which the worms are kept. When you mean to ſhift them, ſpread freſh leaves into the wire baſket; and let it down gently over the worms till it comes within their reach. They no ſooner perceive the freſh food than they abandon the rubbiſh below, and creep through the meſhes, ſo as to fix themſelves upon the leaves; then by gently raiſing the freſh baſket, and drawing out the board below (which ought to be made to ſlip out like the ſlip bottom of a bird's cage), you get off all the excrements and decayed leaves, without incommoding the worms in the ſmalleſt degree; and along with the litter you will draw off an inch or two in depth of the fouleſt mephitic vapours. To get entirely rid of theſe, the board, when thus taken out, ſhould be carried without doors, and there cleaned; and the ſlip board immediately replaced to receive all the excrements and offals. After it is replaced, the wire frame that had been elevated a little, may be allowed to deſcend to a convenient diſtance above the board without touching it. Thus will there be left a vacant ſpace for the mephitic air to fall below the worms, ſo as to allow them to inhabit a wholeſome region of the atmoſphere.

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22 How they may be cleaned without bruiſing them.

When a freſh ſupply of food is to be given before cleaning, the wire frame ought to be let down as cloſe to the board as can be ſafely done, and another wire-bottomed frame put over it, with freſh leaves, as before deſcribed. When the worms have abandoned that in their turn, let the ſlip-board, together with the lower wire frame, be drawn out and removed, and ſo on as often as neceſſary. To admit of this alternate change, every table, conſiſting of one ſlip-board, ought to have two ſets of wire-bottomed frames of the ſame ſize; the ſlip board to be always put into its place immediately after it is cleaned, and the wire frames reſerved to be afterwards placed over the other. By this mode of management, it is probable that the worms would be ſaved from the diſeaſes engendered by the mephitic air, and the numerous deaths that are the conſequence of it avoided.

23 Quicklime would abſorb all the bad air which ſurrounds them.

Dr Anderſon, to whom we have already acknowledged our obligations, and to whom this country has been much indebted for valuable works on agriculture, the fiſheries, &c. adviſes thoſe who have the management of ſilk worms to ſtrew a thin ſtratum of freſh ſlaked quicklime upon the ſlip-board each time it is cleaned, immediately before it is put into its place. This would abſorb the mephitic gas, for as ſoon as it is generated it would deſcend upon the ſurface of the quicklime. Thus would the worms be kept continually in an atmoſphere of pure air (c). Were the walls of the apartments to be frequently waſhed with quicklime and water, it would tend much to promote cleanlineſs at a ſmall expence, and augment the healthineſs of the worms as well as that of the perſons who attend them.

24 Mr Swayne's receptacle for the worms when going to ſpin.

When the ſilk worm refuſes its food, and leaves ſilky traces on the leaves over which it paſſes, it is a proof that it is ready to begin its cocoon. It is now neceſſary to form a new receptacle, which is commonly done by pinning together papers in the ſhape of inverted cones with broad baſes. "This method (ſays Mr Swayne), where there are many worms, is exceedingly tedious, waſtes much paper, and uſes a large number of pins; beſides, as the ſilk worm always weaves an outer covering or defenſive web before it begins the cocoon or oval ball, I apprehended that it cauſed a needleſs waſte of ſilk in forming the broad web at the top. The method I make uſe of is, to roll a ſmall piece of paper (an uncut octavo leaf, ſuch as that of an old magazine, is ſufficient

Tranſactions of the Society for the Encouragement of Arts, vol. vii. p. 123.

(c) To put this queſtion beyond a doubt, Mr Blancard made the following comparative experiments, which were ſeveral times repeated. "I procured (ſays he) four glaſs jars nine inches high and five in diameter, cloſing the mouth with cork ſtoppers. After which I placed in each of them, in their ſecond life (ſo *mue* may be tranſlated which means the ſtage between the different ſickneſſes), twelve ſilk worms, which were fed four times a-day; and which I confined in this kind of priſon all their life, without taking away either their dead companions or their ordure or litter. I ſprinkled with chalk the worms of only two of theſe jars, and kept the two others to compare with them.

"In thoſe without lime, I never obtained neither more nor leſs than three ſmall and imperfect cocoons (*chiques ou bouffard*), and in the two that were ſprinkled with lime, I had very often twelve, and never leſs than nine fine full-ſized firm cocoons."

This experiment affords the moſt ſatisfactory proof of the utility of this proceſs. From a number of trials he found, that even when the worms were covered with a very large proportion of lime, they never were in any way incommoded by it.

Silk. sufficient for three), round my fore-finger, and to give it a twiſt at the bottom; which is done with the utmoſt expedition, and gives no occaſion for the uſe of pins. Theſe rolled paper-caſes being likewiſe of a form more nearly reſembling that of a cocoon, with a much narrower opening on the top than the others, takes away the neceſſity of waſting much ſilk in the outer web, and conſequently leaves more to be employed in forming the ball. The ſilk is readily taken out of theſe cases by untwiſting the bottom; and if this be done with moderate care, and the papers are preſerved, they will ſerve ſeveral times for the like purpoſe."

25 Others recommend buſhes of heath.

Others adviſe, that when the ſilk worms are preparing to ſpin, little buſhes of heath, broom, or twigs, ſhould be ſtuck upright near the ſhelf or box in which they are incloſed: the worms mount theſe, and attach their web to them.

26 How ſilk worms may be revived when affected by thunder. *Tranſactions of the American Philoſophical Society*, vol. ii.

When the worms are ready to mount, in order to ſpin, if the weather be hot, attended with thunder, you will ſee them in a languiſhing condition; your care muſt then be to revive them, which is effected thus: Take a few eggs and onions, and fry them in a pan with ſome ſtale hog's lard, the ranker the better, and make pancake; which done, carry it ſmoaking hot into the room where they are kept, and go round the chamber with it. You will be ſurpriſed to ſee how the ſmell revives them, excites thoſe to eat who have not done feeding, and makes the others that are ready to ſpin climb up the twigs.

27 Different kinds of cocoons.

In about ten or twelve days, according to the accounts which we have received from Mr Andrew Wright of Paiſley, it may be ſafely concluded, that if the worms have finiſhed their work, the cocoons may be collected.

We ſhall now diſtinguiſh the cocoons from one another according to their value or their uſe, and conſider the method of managing each. They may be diſtinguiſhed into the good and bad. The good cocoons may be known by theſe marks: they are little, ſtrong, and firm; have a fine grain, both ends are round, and they are free from ſpots. Among the good cocoons alſo may be arranged thoſe which are called *calcined* cocoons, in which the worm, in conſequence of ſickneſs, is petrified or reduced to a fine powder. Theſe cocoons produce more ſilk than others, and are ſold in Piedmont at half as much again. They may be diſtinguiſhed by the noiſe which the worm makes when the cocoon is ſhaken. Of the bad cocoons there are ſix ſpecies: 1. The *pointed cocoons*, one extremity of which ends in a point; the ſilk which covers the point is weak, and ſoon breaks or tears. 2. The *cocalons*, which are bigger, but the contexture is weak. 3. The *dupions*, or double cocoons, which have been formed by the joint labour of two and ſometimes of three worms. 4. The *ſouffions*, which have a looſe contexture, ſometimes ſo looſe that they are tranſparent. 5. The *perforated cocoons*, which have a hole at one end. 6. The *bad choquette*, which is compoſed of defective cocoons, ſpotted or rotten. Beſides theſe there is the *good choquette*, which does not properly belong to either of theſe two claſſes: it is formed of thoſe cocoons in which the worm dies before the ſilk is brought to perfection. The worms adhere to one ſide of the cocoon, and therefore when the cocoon is ſhaken will not rattle: the ſilk is as fine, but is not of ſo bright a colour, nor is ſo ſtrong and nervous, as that which is obtained from good cocoons.

Silk. 28 Mr Wright's inſtructions for ſelecting and preſerving the royal cocoons.

The cocoons which are kept for breeding are called *royal* cocoons. For ſelecting and preſerving theſe, we have been favoured with ſome valuable inſtructions by Mr Wright of Paiſley, which we ſhall preſent to our readers.—The largeſt and beſt cocoons ought to be kept for breed, about an equal number of males and females; the cocoons that contain the former are ſharper pointed at the ends than thoſe that contain the latter. Although it ſhould happen that there are more females than males, little inconvenience or ill conſequences can ariſe from it, as one male will ſerve two or three females, if the time of their coming out of the cocoons anſwer. About 12 or 15 days after they begin to ſpin, the cocoons for breed may be laid on ſheets of white paper; about this time the moth opens for itſelf a paſſage through the end of its cocoon, and iſſues out. When the female has laid her eggs, which on an average may amount to 250, they are ſpread upon ſheets of paper and hung up to dry in ſome place where they may not be expoſed to the heat of the ſun: after being dried they muſt be kept in a cool well-aired place, where neither vapours nor moiſture can reach them. That they may be preſerved from external accidents, as inſects of different kinds will deſtroy them, and mice is their enemy in all the ſtages of their exiſtence, they ſhould be kept in ſtone pots or glaſs bottles with their mouths ſtopped, and there remain until brought out next ſeaſon to be hatched.

29 How to prepare the cocoons for being wound.

The cocoons from which the ſilk is to be immediately wound muſt be expoſed to the heat of an oven, in order to kill the chryſalis or aurelia, which would otherwiſe eat its way through the cocoon, and render it uſeleſs. The following directions are given for managing this proceſs by one of the firſt ſilk manufacturers in Italy.

Tranſactions of the American Philoſophical Society, vol. ii.

Put your cocoons in long ſhallow baſkets, and fill them up within an inch of the top. You then cover them with paper, and put a wrapper over that. Theſe baſkets are to be diſpoſed in an oven, whoſe heat is as near as can be that of an oven from which the bread is juſt drawn after being baked. When your cocoons have remained therein near an hour, you muſt draw them out; and to ſee whether all the worms are dead, draw out a dupion from the middle of your baſket and open it: if the worm be dead, you may conclude all the reſt are ſo; becauſe the contexture of the dupion being ſtronger than that of the other cocoons, it is conſequently leſs eaſy to be penetrated by the heat. You muſt obſerve to take it from the middle of the baſket, becauſe in that part the heat is leaſt perceptible. After you have drawn your baſkets from the oven, you muſt firſt cover each of them with a woollen blanket or rug, leaving the wrapper beſides, and then you pile them above one another. If your baking has ſucceeded, your woollen cover will be all over wet with a kind of dew, the thickneſs of your little finger. If there be leſs, it is a ſign your cocoons have been too much or too little baked. If too much baked, the worm, being over-dried, cannot tranſpire a humour he no longer contains, and your cocoon is then burnt. If not enough baked, the worm has not been ſufficiently penetrated by the heat to diſtil the liquor he contains, and in that caſe is not dead.

You muſt let your baſkets ſtand thus covered five or ſix hours if poſſible, in order to keep in the heat, as this makes an end of ſtifling thoſe worms which might have avoided the firſt impreſſion of the fire. You are likewiſe

Silk. wiſe to take great care to let your cocoons ſtand in the oven the time that is neceſſary; for if they do not ſtand long enough, your worms are only ſtunned for a time and will afterwards be revived. If, on the other hand, you leave them too long in the oven, you burn them: many inſtances of theſe two caſes are frequently to be met with. It is a good ſign when you ſee ſome of the butterflies ſpring out from the cocoons which have been baked, becauſe you may be certain they are not burnt. For if you would kill them all to the laſt worm, you would burn many cocoons which might be more expoſed to the heat than that particular worm.

30 How the ſilk is to be wound from the cocoons.

The next operation is the winding of the ſilk. Before you begin to wind, you muſt prepare your cocoons as follows:

1. In ſtripping them of that waſte ſilk that ſurrounds them, and which ſerved to faſten them to the twigs. This burr is proper to ſtuff quilts, or other ſuch uſes; you may likewiſe ſpin it to make ſtockings, but they will be coarſe and ordinary.

2. You muſt ſort your cocoons, ſeparating them into different claſſes in order to wind them apart. Theſe claſſes are, the good white cocoons; the good cocoons of all the other colours; the dupions; the cocalons, among which are included the weak cocoons; the good choquette; and, laſtly, the bad choquette. In ſorting the cocoons, you will always find ſome perforated cocoons amongſt them, whoſe worm is already born; thoſe you muſt ſet apart for fleuret. You will likewiſe find ſome ſoufflons, but very few; for which reaſon you may put them among the bad choquette, and they run up into waſte.

The good cocoons, as well white as yellow, are the eaſieſt to wind; thoſe which require the greateſt care and pains are the cocalons; you muſt wind them in cooler water than the others, and if you take care to give them to a good windſter, you will have as good ſilk from them as the reſt. You muſt likewiſe have careful windſters for the dupions and choquettes. Theſe two ſpecies require hotter water than the common cocoons.

The good cocoons are to be wound in the following manner: Firſt, chooſe an open convenient place for your filature, the longer the better, if you intend to have many furnaces and coppers. The building ſhould be high and open on one ſide, and walled on the other, as well to ſcreen you from the cold winds and receive the ſun, as to give a free paſſage to the ſteam of your baſons or coppers.

Theſe coppers or baſons are to be diſpoſed (when the building will admit of it) in a row on each ſide of the filature, as being the moſt convenient method of placing them, for by that means in walking up and down you ſee what every one is about. And theſe baſons ſhould be two and two together, with a chimney between every couple.

Having prepared your reels (which are turned by hands, and require a quick eye), and your fire being a light one under every baſon, your windſter muſt ſtay till the water is as hot as it can be without boiling. When every thing is ready, you throw into your baſons two or three handfuls of cocoons, which you gently bruſh over with a wiſk about ſix inches long, cut ſtumpy like a broom worn out: by theſe means the threads of the cocoons ſtick to the wiſk. You muſt diſengage theſe threads from the wiſk, and purge them by drawing theſe ends with your fingers till they come off entirely clean. This operation is called *la Battue*. Silk.

When the threads are quite clear, you muſt paſs four of them (if you will wind fine ſilk) through each of the holes in a thin iron bar that is placed horizontally at the edge of your baſon; afterwards you twiſt the two ends (which conſiſt of four cocoons each) twenty or twenty-five times, that the four ends in each thread may the better join together in croſſing each other, and that your ſilk may be plump, which otherwiſe would be flat.

Your windſter muſt always have a bowl of cold water by her, to dip her fingers in, and to ſprinkle very often the ſaid bar, that the heat may not burn the thread.

Your threads, when thus twiſted, go upon two iron hooks called rampins, which are placed higher, and from thence they go upon the reel. At one end of the axis of the reel is a cog-wheel, which catching in the teeth of the poſt-rampin, moves it from the right to the left, and conſequently the thread that is upon it; ſo that your ſilk is wound on the reel croſsways, and your threads form two hanks of about four fingers broad.

As often as the cocoons you wind are done, or break or diminiſh only, you muſt join freſh ones to keep up the number requiſite, or the proportion; becauſe, as the cocoons wind off, the thread being finer, you muſt join two cocoons half wound to replace a new one: Thus you may wind three new ones and two half wound, and your ſilk is from four to five cocoons.

When you would join a freſh thread, you muſt lay one end on your finger, which you throw lightly on the other threads that are winding, and it joins them immediately, and continues to go up with the reſt. You muſt not wind off your cocoons too bare or to the laſt, becauſe when they are near at an end, the *bairré*, that is, the huſk, joins in with the other threads, and makes the ſilk foul and gouty.

When you have finiſhed your firſt parcel, you muſt clean your baſons, taking out all the ſtriped worms, as well as the cocoons, on which there is a little ſilk, which you firſt open and take out the worm, and then throw them into a baſket by you, into which you likewiſe caſt the looſe ſilk that comes off in making the battue.

You then proceed as before with other two or three handfuls of cocoons; you make a new battue; you purge them, and continue to wind the ſame number of cocoons or their equivalent, and ſo to the end.

As was already mentioned, the windſter muſt always have a bowl of cold water by her, to ſprinkle the bar, to cool her fingers every time ſhe dips them in the hot water, and to pour into her baſon when neceſſary, that is, when her water begins to boil. You muſt be very careful to twiſt your threads a ſufficient number of times, about 25, otherwiſe your ſilk remains flat, inſtead of being round and full; beſides, when the ſilk is not well croſſed, it never can be clean, becauſe a gout or nub that comes from a cocoon will paſs through a ſmall number of theſe twiſts, though a greater will ſtop it. Your thread then breaks, and you paſs what foulneſs there may be in the middle of your reel between

Silk. tween the two hanks, which ſerves for a head-band to tie them.

You muſt obſerve that your water be juſt in a proper degree of heat. When it is too hot, the thread is dead, and has no body; when it is too cold, the ends which form the thread do not join well, and form a harſh ill-qualified ſilk.

You muſt change the water in your baſon four times a-day for your dupions and choquette, and twice only for good cocoons when you wind fine ſilk; but if you wind coarſe ſilk, it is neceſſary to change it three or four times. For if you were not to change the water, the ſilk would not be ſo bright and gloſſy, becauſe the worm contained in the cocoons foul it very conſiderably. You muſt endeavour as much as poſſible to wind with clear water, for if there are too many worms in it, your ſilk is covered with a kind of duſt which attracts the moth, and deſtroys your ſilk.

You may wind your ſilk of what ſize you pleaſe, from one cocoon to 1000; but it is difficult to wind more than 30 in a thread. The nicety, and that in which conſiſts the greateſt difficulty, is to wind even; becauſe as the cocoon winds off, the end is finer, and you muſt then join other cocoons to keep up the ſame ſize. This difficulty of keeping the ſilk always even is ſo great, that (excepting a thread of two cocoons, which we call ſuch) we do not ſay a ſilk of three, of four, or of ſix cocoons; but a ſilk of three to four, of four to five, of ſix to ſeven cocoons. If you proceed to a coarſer ſilk, you cannot calculate ſo nicely as to one cocoon more or leſs. We ſay, for example, from 12 to 15, from 15 to 20, and ſo on.

31 What number of worms produce a certain quantity of ſilk. What number of worms are neceſſary to produce a certain quantity of ſilk has not been aſcertained. And as different perſons who wiſhed to determine this point have had different reſults, the truth ſeems to be, that from various circumſtances the ſame number of worms may produce more ſilk at one time than at another. It is related in the ſecond volume of the Tranſactions of the Society for encouraging Arts, &c. that Mrs Williams obtained nearly an ounce and a half of ſilk from 244 cocoons. Mr Swayne from 50 cocoons procured 100 grains. Miſs Rhodes obtained from 250 of the largeſt cocoons, three quarters of an ounce and a dram. From a paper in the ſecond volume of the American Tranſactions, which we have before referred to in the courſe of this article, we are informed that 150 ounces of good cocoons yield about 11 ounces of ſilk from five to ſix cocoons: if you wind coarſer, ſomething more. But what appears aſtoniſhing, Mr Salvatore Bertezen, an Italian, to whom the Society for encouraging Arts, &c. adjudged their gold medal, raiſed five pounds of excellent ſilk from 12,000 worms.

32 Length of the threads. The cocoons produce a thread of very unequal length; you may meet with ſome that yield 1200 ells, whilſt others will ſcarcely afford 200 ells. In general, you may calculate the production of a cocoon from 500 to 600 ells in length.

33 Advantages of Mr Sholl's improved ſilk loom. As there is every reaſon to hope that the ſilk manufacture will ſoon be carried on with ardour in this country, and to a great extent, we are happy to learn that the ſilk-loom has been much improved lately by Mr Sholl of Bethnal-Green. It appears from the evidence of ſeveral gentlemen converſant in that branch of ſilk weaving to which this loom is particularly adapted, that the advantages of this conſtruction are, the gaining light, a power of ſhortening the porry occaſionally, ſo as to ſuit any kind of work, being more portable, and having the gibbet firmly fixed, together with the diminution of price; which, compared with the old loom, is as five pounds, the price of a loom on the old conſtruction, to three pounds ten ſhillings, the price of one of thoſe contrived by Mr Sholl; and that, as the proportion of light work is to ſtrong work as nine to one, this ſort of loom promiſes to be of very conſiderable advantage, particularly in making modes, or other black work.

Silk || Silphium.

Tranſactions of the Society for encouraging Arts, &c. vol. viii.

34 Deſcription of it. As a plate of this loom, with proper references, will render its advantages moſt intelligible, we ſhall ſubjoin theſe: Plate CCCCLXVI. A, A, The ſills; B, B, The breaſt-roll poſts: C, The cut tree; D, D, The uprights; E, The burdown; F, The batton; G, The reeds; H, The harneſs; I, The breaſt-roll; K, The cheeſe; L, The gibbet: M, The treddles; N, The tumblers; O, Short counter-meſhes; P, Long counter-meſhes; Q, The porry; R, R, Cane-roll poſts; S, The cane-roll; T, The weight bar and weight; U, U, Counter-weights; W, The breaking rod; X, X, Croſs rods.

Silk-Worm. See Silk.

SILPHA, Carrion-beetle, in natural hiſtory; a genus of animals belonging to the claſs of *inſectæ*, and to the order of *coleopteræ*. The antennæ are clavated; the clava are perfoliated; the elytra marginated; the head is prominent; and the thorax marginated. There are 94 ſpecies, of which ſeven only are natives of Britain and Ireland. 1. The *veſpillo*. The margin of the thorax broad. The ſhells abbreviated, black, with two yellow belts. The thighs of the hind legs large, with a ſpine near their origin. Length near one inch. It infeſts dead bodies. 2. The *biphuſtulata*, is black; the antennæ are long and ſmall, and there are two red ſpots on the middle of each ſhell. The length is one-third of an inch. 3. The *puſtulata*, is black and oblong: there are four brown ſpots on the ſhells: the length is one-fifth of an inch. It lives on trees. 4. The *quadripunctata*. The head, antennæ, and legs black. Margin of the thorax and ſhells are of a pale yellow, with four black ſpots. The length half an inch. It is found in Cain-wood, near Hampſtead. 5. The *ſabuloſa*, is black; the antennæ are ſhort and globular; there are five ſtriæ on each ſhell. The ſhells and wings are ſhort. There are five joints on the two firſt feet, four on the reſt. It lives in ſand. 6. The *aquatica*, is brown, with a green bronze tinge. There are four ribs on the thorax. On each ſhell there are 10 ſtriæ. The length is one-fifth of an inch. 7. The *pulicaria*, is black and oblong; the ſhells are abbreviated; the abdomen is rounded at the extremity; the thorax and ſhells are ſcarce marginated; the length is one line. It is found frequently running on flowers. *Berkenhout*, vol. i.

SILPHIUM, in botany: A genus of plants belonging to the claſs of ſyngeneſia, and to the order of polygamia neceſſaria; and in the natural ſyſtem arranged under the 49th order, *compoſitæ*. The receptacle is paleaceous; the pappus has a two-horned margin, and the calyx is ſquarroſe. There are eight ſpecies; the laciniatum, terebinthinum, perfoliatum, connatum, aſteriſcum, trifoliatum, ſoldaginoides, and trilobatum. The firſt ſix of theſe are natives of North America.

SIL-

Silver.

SILVER, one of the perfect metals, and the whiteſt and moſt brilliant among them all, is of the ſpecific gravity, according to Bergman, of 10.552; but according to Kirwan, of 11.095. Its ductility is not greatly inferior to that of gold, as a grain of ſilver leaf meaſures ſomewhat more than 51 ſquare inches; and the ſilver wire uſed for aſtronomical purpoſes meaſures only the 750th part of an inch in diameter; which is no more than half the thickneſs of the hair of the human head. It is harder and more elaſtic than lead, tin, or gold; but leſs ſo than copper, platina, or iron: like other metals it grows hard by hammering, but is eaſily reduced to its former ſtate by annealing. It is more deſtructible than gold, and is particularly acted upon by ſulphureous vapours; hence its ſurface tarniſhes in the air, and aſſumes a dark brown colour.

Cronſtedt's Mineralogy, vol. ii. p. 536.

"It has been long thought (ſays Mr Fourcroy) that ſilver is indeſtructible by the combined action of heat and air. It is certain, that this metal kept in fuſion, without contact of air, does not appear to be ſenſibly altered; yet Junker had affirmed, that by treating it a long time in the reverberatory furnace, in the manner of Iſaac Hollandus, ſilver was changed into a vitreous calx. This experiment has been confirmed by Macquer. That learned chemiſt expoſed ſilver 20 times ſucceſſively in a porcelain crucible to the fire of the furnace at Seves; and at the 20th fuſion he obtained a vitriform matter of an olive green, which appeared to be a true glaſs of ſilver. This metal, when heated in the focus of a burning glaſs, has always exhibited a white pulverulent matter on its ſurface, and a greeniſh vitreous covering on the ſupport it reſted upon. Theſe two facts remove all doubt reſpecting the alteration of ſilver: though it is much more difficult to calcine than other metallic matters, yet it is capable of being converted after a long time into a white calx, which, treated in a violent fire, affords an olive-coloured glaſs. It may be poſſible perhaps to obtain a calx of ſilver by heating this metal when reduced into very fine laminæ, or into leaves, for a very long time in a matraſs, as is done with mercury."

Magellan informs us, that by melting in a due proportion with gold or ſteel, ſilver becomes greeniſh or bluiſh; ſo that it is capable of producing the white, yellow, red, green, blue, and olive colours, more or leſs conſpicuouſly according to the various circumſtances of heat and proportions of the mixture. Though he makes mention of the vitrifications by Macquer already taken notice of, he denies that it can be calcined by heat alone. "Silver (ſays he) is ſo fixed by itſelf in the fire, that, after being kept a whole month in fuſion, it had only loſt one 60th part of its weight, which might be on account of ſome alloy. It is therefore incapable of being calcined by mere heat; and the calx of ſilver, which can only be made by means of its ſolution in acids, is reducible to its metallic form without the addition of any oxigenous ſubſtance. But when ſilver is expoſed to the violent heat of the ſolar rays collected by a powerful lens, a kind of ſmoke is ſeen ſurrounding it, which proves at laſt to be the minute particles of the metal raiſed and diſperſed by heat, as is evident if a thin plate of gold be expoſed to it; for then the particles of ſilver are ſeen upon the gold in the ſame manner as thoſe of gold are ſeen upon ſilver in a ſimilar experiment."

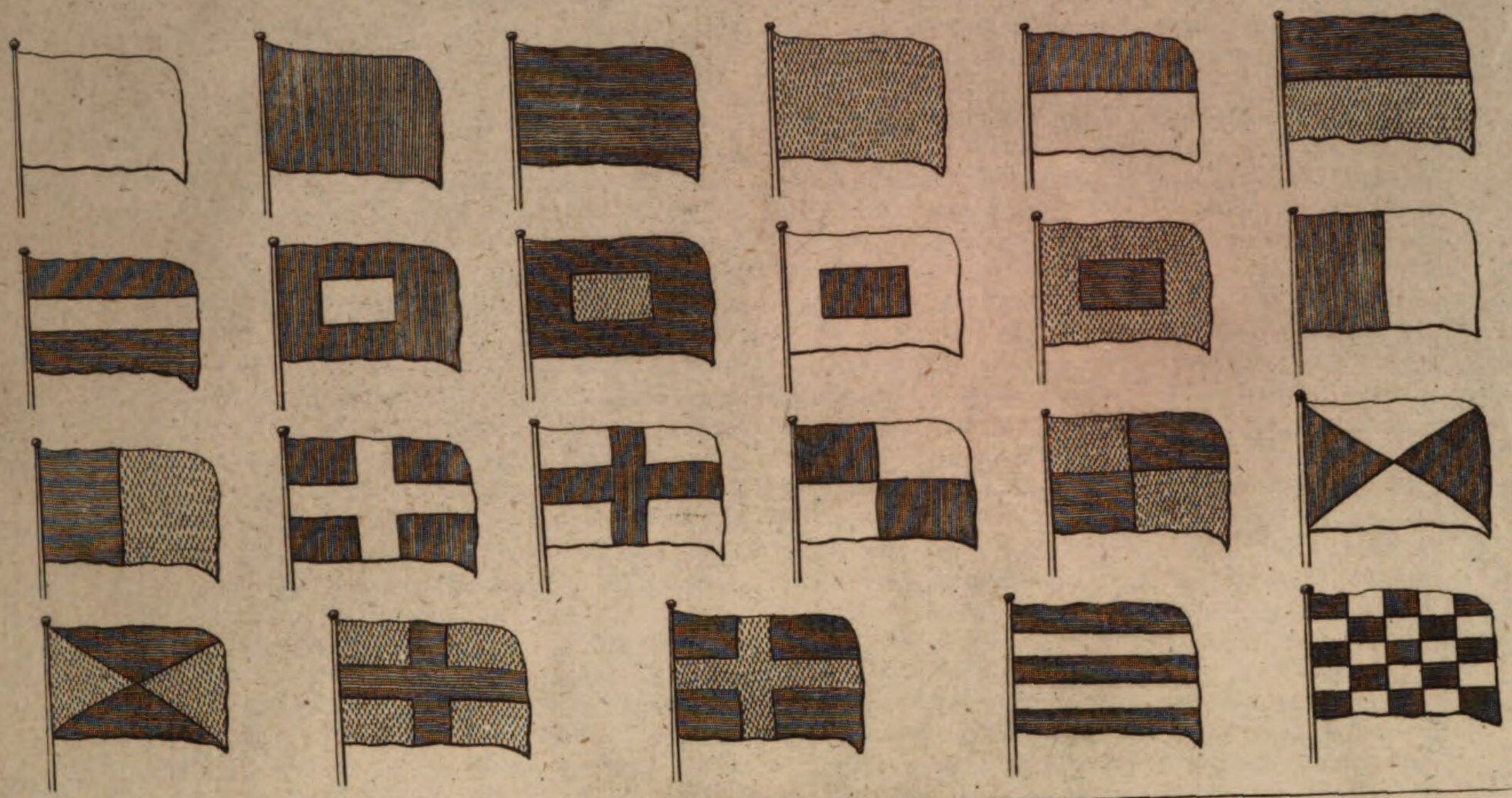
By ſlow cooling after it has been melted, ſilver cryſtallizes into quadrangular pyramids. M. Baumé obſerves, that, in cooling, it aſſumes a ſymmetrical form, obſervable on the ſurface by ſmall fibres reſembling the feathers of a pen. M. Fourcroy obſerves, that the fine button obtained by cupellation, often preſents on its ſurface five or ſix ſides arranged amongſt each other like a pavement; but the cryſtallization in tetrahedral pyramids has not been obſerved particularly excepting by Meſſrs Tillet and Mongez. It has been ſuppoſed that ſilver melts with a ſmaller degree of heat than copper; but the late improved thermometer of Mr Wedgewood ſhows that this is a miſtake; ſilver requiring 130° of Fahrenheit more than copper to bring it into fuſion. It is found in the earth,

1. *Native*, generally of the fineneſs of 16 carats; and of this there are ſeveral varieties. 1. Thin plated or leaved. 2. Capillary ſilver, of fine or coarſe fibres or arboreſcent, from Potoſi in America and Kunſberg in Norway. 3. A kind is alſo met with reſembling coarſe linen in the ſurface, which in Saxony is called *knit cobalt*. Abundance of this kind is to be met with in Potoſi, but more rarely in Saxony and Norway. 4. Sometimes native ſilver is met with in a cryſtalline or regularly figured ſtate with ſhining ſurfaces. This is found at Kunſberg, but is very ſcarce. There appears likewiſe a kind of cryſtallization on the thin plates of native ſilver, their ſurfaces being full of minute pyramidal cryſtals. Moſt of the American ſilver is of the native kind; ſo is that at Kunſberg in Norway. It is not, however, met with native ſo commonly in other European mines. A very ſmall quantity of it is found in the mines of Salberg in Weſtmanland, and of Lofaſen in Dalarne, and ſeveral other places in Sweden. It has been found in pretty large lumps in clay mixed with nickel, partly decayed or withered; in which ſituation it formed the compound called the *ſtercus anſerinum*, or gooſe dung ore. 5. A piece of native ſilver in coal is ſhown in the mineralogical academy at Freyberg; and Lahman, quoted by Le Camus, ſpeaks alſo of a ſimilar ſilver ore found in a mine of pit-coal †. The capillary ſilver, according to the obſervations of Henckel and Rome de Liſle, ſeems to have been produced by a decompoſition of red ſilver ore; and Wallerius affirms, that if ſulphur is mixed in a gentle heat with ſilver, the latter takes a capillary form. 6. Native ſilver is likewiſe ſometimes found in the form of ſpider's webs, and for that reaſon called by the Spaniards *arane*. 7. It is met with in branches formed by octaedrons inſerted into one another. Some of theſe ſhow the mark of a leaf of fern or of a tree; others are cubes or ſingle octaedrons, whoſe angles are truncated, tho' theſe laſt are but rare. 8. It is often found diſperſed through ſand and ochre, as well as in grey limeſtone in Lower Auſtria, and in a greeniſh clay near Schemnitz, or mixed with ochre, clay, and calciform nickel. It is generally alloyed with copper, ſometimes with gold, iron, or regulus of antimony; and ſometimes it contains even five per cent. of arſenic. That found near Kunſberg contains ſo much gold, that the colour of it is yellow.

† *Cronſtedt's Mineralogy*, p. 542.

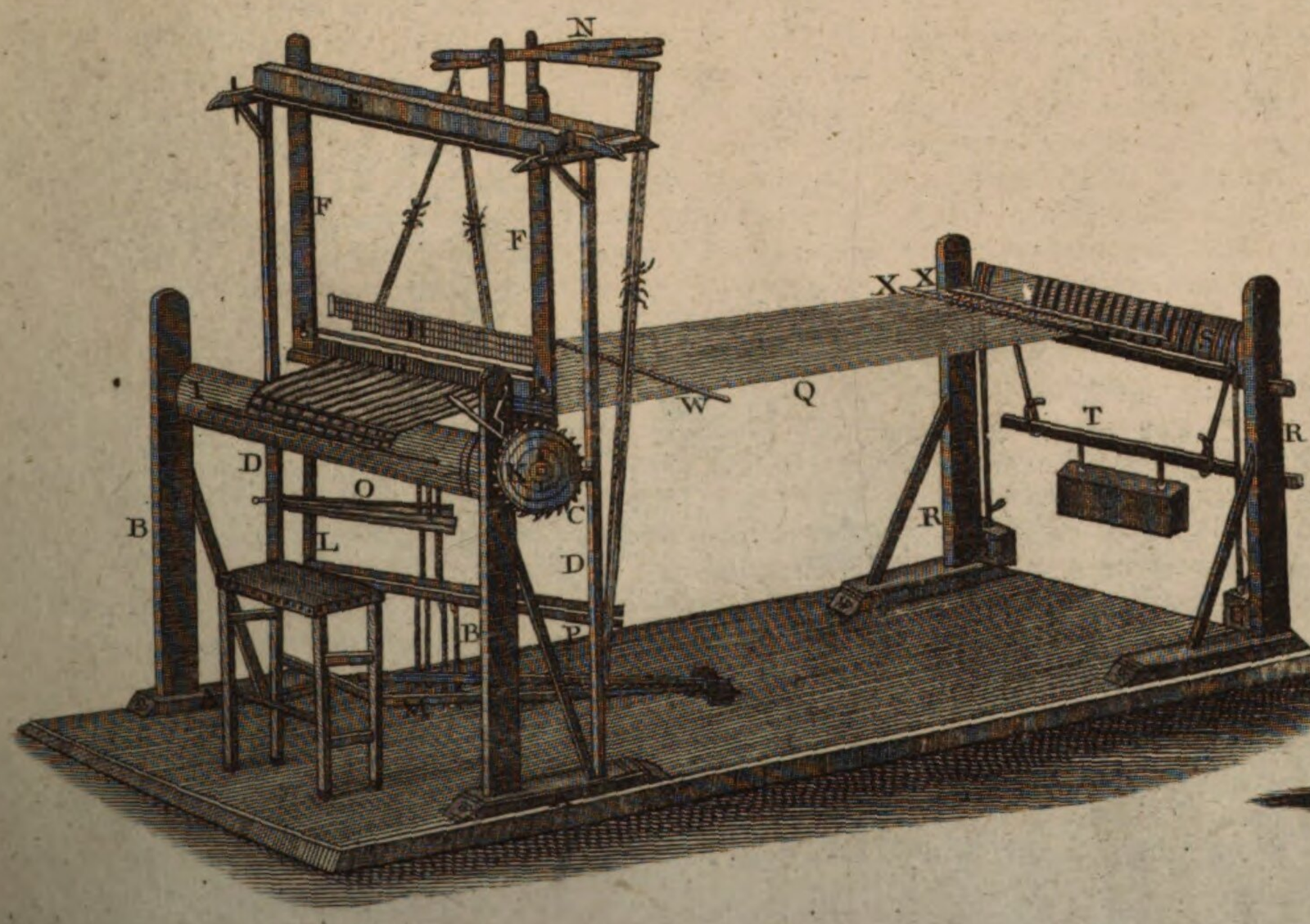
Wallerius diſtinguiſhes ſeven ſpecies of native ſilver; viz. 1. In irregular maſſes and lumps, at Kunſberg in Norway and other places, in a bed of clay. 2. In a granular and jagged form in America and Norway. 3. Arboreſcent, in the places already mentioned. 4. In thin

Naval SIGNALS.

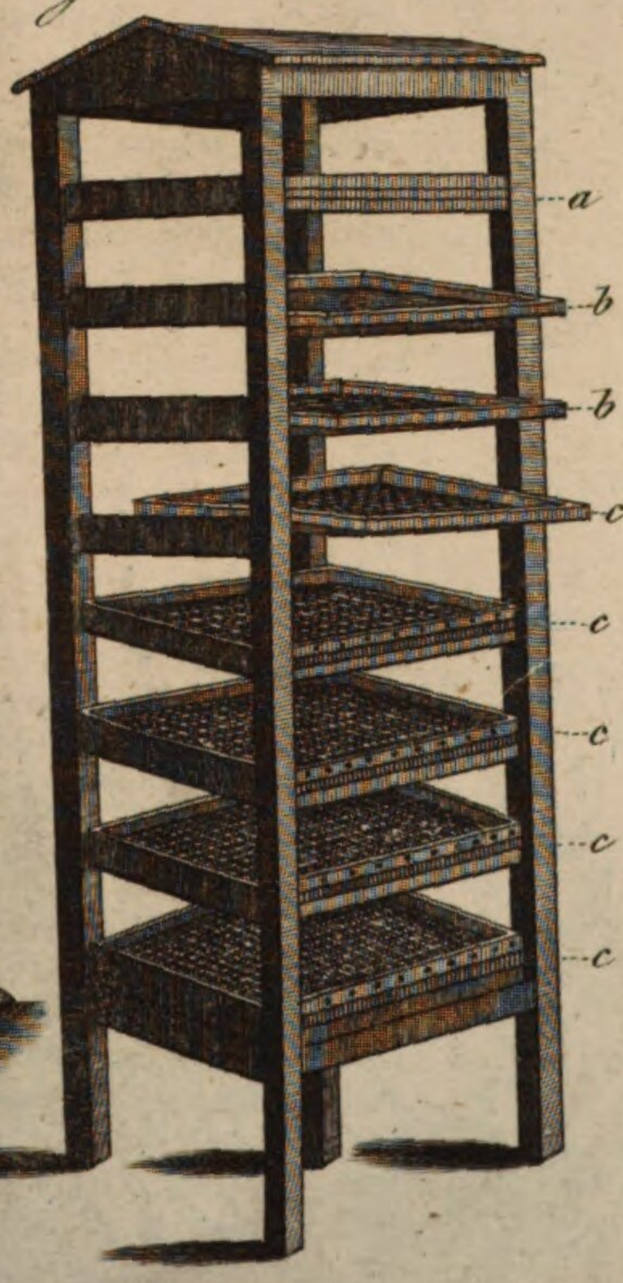


A Silk Loom

improved by Mr. Saml. Sholl.



The Revd. Mr. Swayne's apparatus for rearing Silk Worms.



A. Bell Prin. Wal. Sculptor fecit.

Silver. thin leaves, between the fiſſures of ſtones, in Norway and Germany. In a capillary form, in the places already mentioned, including the cobweb ſilver of the Spaniards already mentioned. 6. Cryſtallized. 7. Superficial. Mr Daubenton enumerates eight varieties of native white ſilver, of different forms, moſt of which have been already enumerated. The materials in which this metal is moſt commonly found in its native ſtate are, baro-ſelenite, limeſtone, ſelenite, quartz, chert, flint, ſerpentine, gneiſs, agate, mica, calcareous ſpar, pyrites, ſchiſtus, clay, &c. Sometimes it is met with in large maſſes, of the weight of 60 pounds or more, in or near the veins of moſt metallic ores, particularly in Peru and in various parts of Europe, of a white, brown, or yellowiſh colour. In Norway and at Alſace it is found in the form of ſolitary cubes and octahedral lumps, of 50 and 60 pounds weight.

2. *Native ſilver alloyed with other metals.* 1. With gold, as in Norway, where it contains ſo much as to appear of a yellow colour. 2. With copper. 3. With gold and copper. 4. Amalgamated with mercury, as in the mines of Salberg. M. Rome de Liſle mentions a native amalgam of ſilver and mercury found at Muſchel Landſberg in the duchy of Deux Ponts, in a ferruginous matrix, mixed with cinnabar, and cryſtallized in a hexagonal form, and of a large ſize. It was before the French revolution preſerved in the king's cabinet at Paris. 5. With iron. According to Bergman, this ore contains two per cent. of iron; but Mongez informs us, that it often does not exceed one per cent. 6. With lead. "Silver (ſays Mr Magellan) is always contained in lead, though the quantity is generally inſufficient to defray the expence of ſeparating it. In the reign of Edward I. of England, however, near 1600 pounds weight of ſilver were obtained, in the courſe of three years, from a lead mine in Devonſhire, which had been diſcovered about the year 900. The lead mines in Cardiganſhire have at different periods afforded great quantities of ſilver; ſo that Sir Hugh Middleton is ſaid to have cleared from them L. 2000 in a month. The ſame mines in the year 1745 yielded 80 ounces of ſilver out of every ton of lead. The lead in only one of the ſmelting houſes at Holywell in Flintſhire produced no leſs than 37521 ounces, or 3126¼ pounds of ſilver from the year 1754 to 1756, and from 1774 to 1776. There are ſome lead ores in England, which, though very poor in that metal, contain between 300 and 400 ounces of ſilver in a ton of lead; and it is commonly obſerved, that the pooreſt lead ores are the richeſt in ſilver; ſo that a large quantity of ſilver is probably thrown away in England by not having the pooreſt ſort of lead ores properly eſſayed." 7. Mr Monnet found ſilver united with arſenic among the ores which came from Guadanal canal in Spain, and an ore of the ſame kind is furniſhed by the Samſon mine near Andreaberg in the Hartz: but Mr Mongez very properly remarks, that theſe ores muſt be diſtinguiſhed from ſuch as have the arſenic in the form of an acid; for in this caſe they are properly mineralized by it, whilſt there can only be a mixture of native ſilver, or ſome of its calces with arſenic in its reguline form. 8. Bergman mentions ſilver in a ſtate of union with antimony. The ore yields ſome ſmoke when roaſted, but has not the garlic ſmell obſervable in the arſenical ores. 9. The white ſilver ore, found in the mines near Freyberg, has the metal united to the regulus of arſenic and iron, the three metallic ingredients being nearly in equal proportions. All the extraneous matters with which the ſilver is united are ſometimes in exceedingly ſmall proportion, but not to be neglected where they exceed the hundredth part of the whole maſs. 10. A particular kind of ſtony ſilver ores is mentioned by Wallerius under the title of *lapis deæ*, and which contain the following varieties, viz. the calcareous ſilver ore at Annaberg in Auſtria, when the metal is mixed with an alkaline limeſtone; the ſpathoſe ore, either white, variegated, or yellowiſh, found at Schemnitz in Hungary; the quartzoſe white ore in a powdery form, mixed with ferruginous ſcoria, found at Potoſi in America; the dark and variegated quartzoſe ſilver ores, with many other ſubdiviſions diſtinguiſhed from one another by little elſe than their colour.

Silver is found mineralized by various ſubſtances; as,

1. With ſulphur in the glaſſy or vitreous ſilver ore; though this name ſeems rather to belong to the minera argenti cornea or horn ſilver ore, to be afterwards taken notice of more particularly. It is ductile, and of the ſame colour with lead, but quickly becomes very black by expoſure to the air; though ſometimes it is grey or black even when firſt broken. It is found either in large lumps, or inhering in quartz, gypſum, gneiſs, pyrites, &c. Its ſpecific gravity, according to Kirwan, is 7,200. An hundred parts of it contain from 72 to 77 of ſilver, and it is rarely contaminated with any other metal.

Profeſſor Brunnich ſays that it contains 180 merks of ſilver in the hundred weight. The medium between the glaſs ore and the red gilder ore is called *roſch-gewæchs* in Hungary, and *brittle glaſs ore* in Saxony. It is black, and affords a powder of the ſame colour when pounded. In the mines of Himmelfurſt near Freyberg, it is ſaid to have held 140 merks, but theſe pieces are very ſcarce at preſent; and indeed the Hungarian glaſs ores in general are now very ſcarce, as Profeſſor Brunnich informs us, though they are now and then found in the windſhafts, which are frequently covered with a thin membrane or rather cruſt, of the colour of pyrites. Mr Magellan ſays that this ore is nothing elſe but native ſilver penetrated by ſulphur; for, on being expoſed to a ſlow heat, the latter flies off, and the ſilver ſhoots into filaments. There are nine varieties of it. 1. Like *black lead*, or plumbago, the moſt common kind of any. 2. Bruckman mentions a kind *brown* on the outſide and greeniſh within. 3. The *yellow ore* has its colour from ſome arſenic contained in it, which forms an orpiment with the ſulphur. 4. It is alſo found of a *greeniſh*, and 5. *bluiſh* colour; the latter is friable, like the ſcoria of metals, and is called at Freyberg *Schlarekenerz*, or the ore of ſcoria. 6. It is found alſo in the *arboreſcent*. 7. *Lamellated*. 8. *Cryſtallized* into octaedral or hexaedral priſms, and into ten pyramids with ten ſides. 9. Laſtly, it is found *ſuperficial*, or covering the ſtones or maſſes of other ores.

Id. p. 544. Watſon's Eſſays, vol. iii.

2. The pyrites argenteus of Henckel contains ſilver and iron mineralized with arſenic. There are three varieties of it. 1. Hard, white, and ſhining ore, of a compact, lamellar, or fibrous texture. The brighteſt kind has leaſt ſilver, only giving 6 or 8 ounces per quintal, and the richeſt about ten per cent. It is found in Germany and Spain. It contains no ſulphur. 2. Of a yellowiſh white colour, and ſtriated texture reſembling biſmuth, but much harder. It is found in Spain, and yields about 60 per cent. of ſilver. 3. In another kind the

Cronſtedt, p. 550.

Silver. the quantity of arſenic is ſo great, that it would ſcarcely deſerve the name of ſilver ore if the arſenic were not very eaſily diſſipated. It is ſoft and eaſily cut; has a brilliant metallic appearance, and conſiſts of conchoidal laminæ. A quintal contains only from four to ſix ounces of ſilver, but it is eaſily reduced by evaporating the arſenic, after which the ſilver is left behind ſlightly contaminated with iron.

3. The red or ruby ſilver ore, the *rothgulden* of the Germans, has the metal combined with ſulphur and arſenic. It is a heavy ſhining ſubſtance, ſometimes tranſparent, and ſometimes opaque; the colour generally crimſon, though ſometimes grey or blackiſh. It is found in ſhapeleſs maſſes, or cryſtallized in pyramids or polygons, ſometimes dendritical or plated, or with radiated incruſtations. It is found in quartz, flint, ſpar, pyrites, ſparry iron ore, lead ore, cobalt ore, jaſper, baro-ſelenite, gneiſs, &c. When radiated or ſtriated, it is called *rothgulden bluth*. It cracks in the fire, and detonates with nitre. Its ſpecific gravity is from 5,400 to 5,684. Bergman informs us, that this kind contains, in the hundred, 60, ſometimes 70, pounds of ſilver, 27 of arſenic, and 13 of ſulphur. The darkeſt coloured ores are the richeſt, the yellow kinds much poorer; but the moſt yellow do not belong to this ſpecies, being in fact an orpiment with 6 or 7 per cent. of ſilver. This laſt kind is brought chiefly from Potoſi in America, and is called *roſi-cler* by the Spaniards.

4. The *ſchuartz gulden*, or *ſilber mulm*, contains the metal mineralized by ſulphur and a ſmall quantity of arſenic and iron. It is of a black ſooty colour, and was ſuppoſed by Cronſtedt to contain a good quantity of copper, to which its colour was owing; but later experiments have evinced, that there is no copper at all in it. It is either of a ſolid or brittle conſiſtence, and of a glaſſy appearance when broken, or of a looſer texture, and ſooty or deep black colour; or it is found like moſs, or thin leaves, lying on the ſurface of other ſilver ores, or thoſe of lead and cobalt, or in clays, ponderous ſpar, gneiſs, &c. It contains from 25 to 60 per cent. of ſilver.

Kirwan's Mineralogy.

5. The *minera argenti alba*, the *Weiſſgulden ore* of the Germans, is a heavy, ſoft, opaque ſubſtance, fine grained or ſcaly, bright and ſhining in its fractures, of a whitiſh, ſteely, or lead colour; ſometimes cryſtallized in pyramidical or cylindrical forms, but often in amorphous grains, or reſembling moſs, or in the form of thin laminæ incruſtating other bodies, found in quartz, ſpar, ſtelſtein, pyrites, blend, lead-ore, cobalt-ore, ſparry iron ore, fluors, &c. It is very fuſible. Its ſpecific gravity is from 5 to 5,300. Its proportion of ſilver from 10 to 30 per cent. It is found, though not commonly, in Saxony, Hungary, the Hartz, and St Marie aux Mines.

6. The *weiſertz*, or white ſilver ore, is an arſenical pyrites, containing ſilver. It is met with in the Saxon mines ſo exactly reſembling the common arſenical pyrites, that it cannot be diſtinguiſhed from it by inſpection. Cronſtedt ſuppoſes that the ſilver it contains may exiſt in a capillary form; but Profeſſor Brunnich thinks this is not altogether the caſe. It is very ſcarce, but met with near Freyberg. There is likewiſe a brown *mulm* having the appearance of rags, met with in the crevices and upon the lumps of cubic lead ore in a mine near Clauſthal and other places, which contains a great quantity of ſilver. It is of a whitiſh ſhining colour; hard, granulated, and ſolid, ſometimes ſtriking fire with ſteel. It diſcovers a mixture of arſenic, by emitting a garlic ſmell when heated. Silver.

7. The *leberertz* of the Germans has the metal combined with ſulphurated antimony. It is of a dark grey and ſomewhat browniſh colour. A variety of a blackiſh blue colour is found in the form of capillary cryſtals, and called *federertz* or plumoſe ſilver ore. It is met with in Saxony, and contains ſometimes a mark or half a pound, ſometimes only two, three, or four ounces, and ſometimes only a mere trifle of ſilver, per cent. There is another ſilver ore, alſo called *leberertz*, by the Germans, which contains arſenic and regulus of antimony. This ore is ſometimes alſo found of a dark grey colour; for the moſt part amorphous, but ſometimes cryſtallized into pyramids. It appears red when ſcraped, and contains from one to five per cent. of ſilver. The greateſt part of this ore is copper, and the next arſenic. According to Bergman, the copper amounts to 24 per cent. It is found in Tranſylvania; and a kind was lately diſcovered in Spain, of a hard ſolid conſiſtence, and of a greyiſh blue colour.

8. The *gooſe dung* ores contain ſilver mineralized with ſulphur in combination with iron, arſenic, and cobalt. It looks like the *weiſsgulden*, excepting that the cobalt, by its decompoſition, gives it a roſy appearance. There are two varieties; one of a dull tarniſhed ſurface and ferruginous look; the other has a ſhining appearance like the *leberertz*. It contains from 10 to 40 or 50 per cent. of ſilver. The arſenic is in an acid ſtate, and united to the cobalt.

9. The *dal fahlertz* contains ſilver mineralized with ſulphurated copper and antimony, and reſembles the dark-coloured *weiſſgulden*, giving a red powder when rubbed. It is found either ſolid or cryſtallized, and is met with in the province of Dal, where it is melted by a very difficult proceſs, calculated to preſerve the different metals it contains. There is another kind which has arſenic united to the reſt of the ingredients. It is only the grey copper ore impregnated with ſilver, of which it contains from one to twelve per cent. the quantity of copper being from 12 to 24 per cent. and the remainder conſiſting either of ſulphur or arſenic, with a little iron. It is the moſt common of all ſilver ores; and M. Monnet remarks, that where copper is united to arſenic, ſilver is always to be found. A variety has been found at Schemnitz, containing a portion of gold alſo.

10. The *pecheblende* is an ore of zinc containing ſilver, and is met with in the Saxon and Hungarian mines among the rich gold and ſilver ores. It is either of a metallic changeable colour or black. Of theſe there were formerly two varieties, viz. either in the form of fine ſcales or in balls, but the latter is now entirely unknown. A black blend is found in Bohemia, which is very heavy, with the ſurface ſomewhat elevated like ſome kinds of hæmatites, but no ſilver has yet been extracted from it.

11. The *bleyglanz*, potters ore, or galena, contains ſilver mineralized with ſulphurated lead. It is alſo called *pyritous ſilver*, and is of a brown colour, yielding but a very ſmall portion of metal. It is met with at Kunſ-

Silver. berg in Norway. When the silver is combined wit sulphurated lead and antimony, the ore is called *striperz*.

12. The *marcasite* containing silver has the metal united with sulphurated iron. There are great varieties of this ore holding different proportions of the metal; some produce only half an ounce of silver per cent. A liver-coloured marcasite is found at Kunsberg in Norway, containing from three to three ounces and a half of silver per cent.

13. Silver is found mineralized with sulphurated and arsenical cobalt; the stone sometimes containing *dendrites*. These kinds keep well in water, but generally decay in the air, and lose the silver they contain. It is found at Morgenstern near Freyberg and Annaberg.

14. The *butter-milk ore* contains silver mineralized by sulphur, with regulus of antimony and barytes. It is found in the form of thin particles or granular spar. Wallerius says that it is soft like mud, and feels like butter. He suspects it to be produced from other silver ores washed away by running waters. Bomare adds, that the miners look upon it as a certain sign of other ores in the neighbourhood, though some are persuaded that it is only an unripened silver ore, which would soon become perfect.

15. The *combustible* silver ore is a black brittle substance, leaving about six per cent. of silver in its ashes. It is in fact a perfect coal in which silver is found.

16. The *hornertz*, or horn silver ore, in which the silver is united with the muriatic acid, is the scarcest of all the silver ores. It is sometimes found in snowy cubical crystals, but is met with of many different colours. Its principal characteristic is to change to a violaceous browniſh colour when exposed to the sunbeams, as happens also to the artificial luna cornea. It is frequently crystallized in a cubic form, though not always of a white colour. Sometimes it resembles an earth easily fusible without smoke. There is a black kind, friable, and easily reducible to powder; the other is in some degree malleable, may be cut with a knife, and takes a sort of polish when rubbed. The vitreous silver ore, which is sometimes mixed with the horn silver, is soluble in nitrous acid; and this affords a method of separating them, the horn silver ore being insoluble in that menstruum. When the horn silver is free from iron, it generally contains 70 per cent. of silver at least; but these ores mostly contain some portion of iron, a small part of which is even united to the marine acid. This kind of ore was first analysed by Mr Woulfe, who dis-
Phil. Trans. for 1776. covered the presence of the vitriolic acid in it.

17. Another kind of horn silver ore is mentioned by Mr Bergman, in which the metal is mineralized by the vitriolic and marine acids, along with some sulphur. He doubts, however, whether the mineralization be perfect in this case, as the salt and sulphur do not admit of any other than a mechanical union. But since iron is often found in these ores, a marcasite may thus be sometimes formed.

18. The *silver goose dung ore* is of a greenish colour, with a mixture of yellow and red. Some think it is a mixture of red silver ore and calx of nickel.

19. The *foliaceous* silver ore. The colour of this ore is *mortdoré*. Some imagine it to be a native silver ore; others that it is a mixture of galena, ochre, and silver. It is sometimes found in the mountain cork, and is so light that it will swim upon water. It contains but Silver. one ounce of silver per quintal.

These are all the varieties hitherto observed in which silver is met with in the earth, though it may perhaps occur in various other forms. It would be worth while to examine whether, in those countries where gold and silver are found in large quantities, the precious metals may not be contained in some proportion in the most common ores, more especially when the particles of gold and silver have not been able to extricate themselves in such a manner as to lie separate in fissures, veins, or hollow places of the mine. A mineralization of silver with alkali is said to have been lately met with at Annaberg in Austria; but the account of it as yet can scarcely be depended upon. Professor Brunnich says, that the silver contained in the limestone at that place appears to be native when the stone is polished.

The purest silver is that which is extracted from luna cornea, and is the only kind that ought to be trusted in the nice operations of chemistry. The process, however, is very tedious, and presents a very unexpected phenomenon, as this metal, though one of the most fixed, is nevertheless volatilized in the operation in such a manner that it exhales through the pores of the crucible; and small globules of silver are afterwards found in the cover, and even in the support of the crucible. According to Cramer, this loss may be prevented by smearing the crucible with black soap, and mixing with the luna cornea half its weight of oil or tallow, which last must also be added by little and little during the operation.

M. Magellan takes notice of a remarkable appearance *Cronstedt*, observable in dissolving silver in the nitrous acid. He p. 537. observes, that this acid is its specific menstruum, attacking it even when cold with considerable effervescence, growing hot, and emitting a considerable quantity of orange-coloured fumes, which diminish in proportion as the saturation advances. The metal appears of a pale brown colour in the conflict, and the solution becomes quite black. This last appearance, however, is owing to a thin, black, fuliginous substance, like smut, which is at once formed into a crust on the surface of the thin plates of silver in the first attack of the acid upon them. This is a very singular phenomenon, and hitherto unaccounted for, these black crusts being comminuted into smaller and smaller particles by the action of the acid; and, when the effervescence is over, they are seen distinctly to fall to the bottom of the vessel, and to form a black sediment, leaving the liquid solution quite transparent, but of a blue colour inclining to green.—This colour might be attributed to some small mixture of copper, though the silver used in the experiment was of the purer kind. The chemists of Dijon say, that the nitrous solution of silver looks of a fine blue colour, if the acid be pure and well concentrated; but if it has any mixture of vitriolic or marine, a precipitation of vitriolated silver or luna cornea takes place. Afterwards the solution becomes as colourless as water, but gives a lasting black tinge to animal substances. This solution is of great use in chemistry, serving to form the lunar caustic, to purify the common aquafortis from a mixture of the vitriolic and marine acids, and is a very nice test of the existence of these acids in mineral waters.

Silver does not combine with earths, even by the most violent heat, though Mr Fourcroy supposes that its calx

Silver, Silvering.

might give an olive green to glaſs. Mr Magellan informs us, that its calx, precipitated by volatile alkali, gives a yellow colour to glaſs, and that he has ſeen it ſtained in this manner ſo high as almoſt to appear of a red colour. It unites with moſt metals, even with iron. The nature of this alloy has been but little inquired into, though Fourcroy is of opinion that it may probably be of the greateſt utility in the arts. It combines in all proportions with copper, by which it is not deprived of its ductility, but renders it harder and more ſonorous; by which means it is often uſed in bells. It is otherwiſe highly uſeful, on account of its indeſtructibility by fire and air, and its extreme ductility. Its fine colour renders it extremely proper for ornamental purpoſes, and it is applied like gold on the ſurface of different bodies, and even on copper. It likewiſe enters the texture of rich ſilks; but its moſt conſiderable uſe is that of being employed as money of an inferior value to gold. In this caſe, it is alloyed with one-twelfth part of copper. It is likewiſe often employed in making houſehold utenſils of all kinds, though its great price renders it leſs common than it would otherwiſe be for this purpoſe. For plate, it is uſually alloyed with one twenty-fourth of copper, which gives it a greater degree of hardneſs and coherence, without rendering it in the leaſt noxious.

Silver has alſo been uſed in medicine; but its extreme cauſticity, when diſſolved in the nitrous acid, and its inactivity otherwiſe, have brought it into diſuſe. The cryſtals of ſilver have been recommended in very ſmall quantity in dropſical caſes; but they are by no means ſuperior, or even equal in efficacy, to much ſafer medicines. The ſolution of ſilver, under the name of *Greek water*, has been uſed for the purpoſe of dying hair of a dark colour; and the ſame ſolution evaporated to a conſiſtence, and fuſed, forms the lunar cauſtic of the ſhops.

Shell Silver, is prepared of the ſhreds of ſilver leaf, or of the leaves themſelves, for the uſe of painters, after the ſame manner as ſhell gold. See *Shell-Gold*.

SILVERING, the covering of any thing with ſilver. It is uſual to ſilver metals, wood, paper, &c. which is performed either with fire, oil, or ſize. Metal-gilders ſilver by the fire; painter-gilders all the other ways. See Gilding.

To ſilver copper or braſs. 1. Cleanſe the metal with aquafortis, by waſhing it lightly, and immediately throwing it into pure water; or by heating it red-hot, and ſcouring it with ſalt and tartar and pure water with a ſmall wire bruſh. 2. Diſſolve ſome ſilver in aquafortis, in a broad-bottomed glaſs veſſel, or of glazed earth; then evaporate away the aquafortis over a chaffing diſh of coals. 3. Put five or ſix times its quantity of water, or as much as will be neceſſary to diſſolve it perfectly, on the remaining dry calx; evaporate this water with the like heat; then put more freſh water, and evaporate again; and, if need be, the third time, making the fire towards the latter end ſo ſtrong as to leave the calx perfectly dry, which, if your ſilver is good, will be of a pure white. 4. Take of this calx, common ſalt, cryſtal of tartar, of each a like quantity or bulk, and mixing well the whole compoſition, put the metal into pure water, and take of the ſaid powder with your wet fingers, and rub it well on, till you find every little cavity of the metal ſufficiently ſilvered over. 5. If you would have it richly done, you muſt rub on more of the powder; and in the laſt place waſh the ſilvered metal in pure water, and rub it hard with a dry cloth. Silvering of Simia.

Silvering of Glaſſes. See *Foliating of Looking-glaſſes.*

SILURIS, in ichthyology, a genus belonging to the order of piſces abdominales. The head is naked; the mouth ſet round with hairy filaments; the bronchiæ have from 4 to 14 rays; the ray of the pectoral fins, or the firſt dorſal one, is prickly, and dentated backwards.—There are 21 ſpecies, moſt of them natives of the Indian and American ſeas. Mr Haſſelquiſt mentions one called the *clarias* by Linnæus, and *ſcheilan* by the Arabians. If it pricks one with the bone of the breaſt-fin, it is dangerous; and our author ſaw the cook of a Swediſh merchant ſhip die of the poiſon communicated by the prick of one of theſe fiſh. See Electricity, n° 261.

SIMEON *of Durham*, the cotemporary of William of Malmſbury, took great pains in collecting the monuments of our hiſtory, eſpecially in the north of England, after they had been ſcattered by the Danes. From theſe he compoſed a hiſtory of the kings of England, from A. D. 616 to 1130; with ſome ſmaller hiſtorical pieces. Simeon both ſtudied and taught the ſciences, and particularly the mathematics at Oxford; and became precentor of the church at Durham, where he died, probably ſoon after the concluſion of his hiſtory, which was continued by John, prior of Hexham, to A. D. 1156.

SIMIA, the Monkey, a genus of quadrupeds belonging to the claſs of mammalia, and order of primates, in the Linnæan ſyſtem, but by Mr Pennant arranged under the digitated quadrupeds. According to the Linnæan ſyſtem, the characteriſtics of this genus are theſe: There are four cloſe ſet fore-teeth on each jaw; ſingle tuſks on each ſide in both jaws, which are longer than the reſt, and ſomewhat remote from them. The grinders are obtuſe, and the feet are formed like hands. Mr Pennant gives the following generic deſcription of the ſimia. There are four cutting teeth in each jaw, and two canine. Each of the feet are formed like hands, generally with flat nails, and, except in one inſtance, have four fingers and a thumb. There are eyebrows both above and below.

They are a numerous race; but almoſt all confined to the torrid zone. They fill the woods of Africa from Senegal to the Cape, and from thence to Æthiopia. They are found in all parts of India, and its iſlands; in Cochin-China, in the ſouth of China, and in Japan; (and one is met with in Arabia); and they ſwarm in the foreſts of South America, from the iſthmus of Darien as far as Paraguay. They are lively, agile, full of frolic, chatter, and grimace. From the ſtructure of their members, they have many actions in common with the human kind. Moſt of them are fierce and untameable; ſome are of a milder nature, and will ſhow a degree of attachment; but in general they are endowed with miſchievous intellects; and are filthy, obſcene, laſcivious, and thieving. They inhabit the woods, and live on trees; feeding on fruits, leaves, and inſects. In general, they are gregarious, going in vaſt companies; but the different ſpecies never mix with each other, always keeping apart and in different quarters. They leap with vaſt activity from tree to tree, even when

Simia. when loaded with their young, which cling to them. They are the prey of leopards and others of the feline race; and of ſerpents, which purſue them to the ſummits of the trees, and ſwallow them entire. They are not carnivorous, but for miſchief's ſake will rob the neſts of birds of the eggs and young. In the countries where they moſt abound, the ſagacity of the feathered tribe is more marvelouſly ſhown in their contrivances to fix the neſt beyond the reach of theſe invaders.

The ſimiæ being more numerous in their ſpecies than any other animals, and differing greatly in their appearances, it ſeemed neceſſary to methodize and ſubdivide the genus. Accordingly Mr Ray firſt diſtributed them into three claſſes.

Simiæ, Apes, ſuch as wanted tails.

Cercopitheci, Monkeys, ſuch as had tails.

Papiones, Baboons, thoſe with ſhort tails; to diſtinguiſh them from the common monkeys, which have very long ones.

Gmelin's Edition of the Animal Kingdom of Linnæus, by Ker.

The principal marks by which the ſpecies of this genus are diſtinguiſhable from each other, are derived, 1ſt, from the tail, which is either long, ſhort, or altogether wanting, or is ſtraight, or prehenſile; 2dly, from the buttocks, which are naked, and furniſhed with calloſities, or are covered with hair; 3dly, from the nails, which are flat and rounded like thoſe of man, or ſharp pointed like the claws of beaſts in general; 4thly, from the preſence or abſence of a beard on the chin; and, 5thly, from the cheeks being provided with, or wanting, pouches in their under parts. For greater convenience, the ſpecies of this genus, which are very numerous, are arranged under five ſubordinate diviſions, conſidered as diſtinct genera by ſome authors, and not without reaſon. Three of theſe ſubdiviſions were adopted by Linnæus; but Dr Gmelin, following Buffon, has added other two taken from the third diviſion of his great precurſor. Theſe ſubdiviſions are the *ſimiæ*, *papiones*, *cercopitheci*, *ſapaji*, and *ſagoini*.

I. The Simiæ, or Apes. They have no tails. The viſage is flat; the teeth, hands, fingers, feet, toes, and nails, reſemble thoſe of man, and they walk naturally erect. This diviſion includes the ſimiæ, or apes properly ſo called, which are not found in America.

1. The chimpanzee, the ſimia troglodytes of Linnæus, common in the mountains of Sierra Leona, reſembles man more than the orang-outang. This animal was firſt brought to Europe in 1738, when it was exhibited as a ſhow in London. The following deſcription of one that was kept ſome months at the colony of Sierra Leona is given by Wadſtrom, in his Eſſay on Colonization †. He was nearly two feet high; but the full ſtature is nearly five feet. He was covered with black hair, long and thick on the back, but ſhort and thin on the breaſt and belly. His face was bare; his hands and his head reſembled thoſe of an old black man, except that the hair on his head was ſtraight. He ate, drank, ſlept, and ſat at table, like a human being. At firſt he crept on all fours, on the outſide of his hands; but, when grown larger, he endeavoured to go erect, ſupporting himſelf by a ſtick. He was melancholy, but always good natured.

† Part ii. p. 272.

Plate CCCCLXVII. fig. 1.

2. The ſatyrus, orang-outang, or great ape, has a flat face, and a deformed reſemblance of the human; ears like thoſe of a man; the hair on the head longer than on the body. The body and limbs are covered with reddiſh and ſhaggy hair; longeſt on the back, thinneſt on the fore-parts. The face and paws are ſwarthy; the buttocks covered with hair. They inhabit the interior parts of Africa, the iſles of Sumatra, Borneo, and Java. Are ſolitary, and live in the moſt deſert places. They grow to the height of ſix feet; have prodigious ſtrength, and will overpower the ſtrongeſt man. The old ones are ſhot with arrows, the young alone can be taken alive. They live entirely on fruits and nuts. They will attack and kill the negroes who wander in the woods; will drive away the elephants, and beat them with their fiſts or pieces of wood; and will throw ſtones at people that offend them. They ſleep in trees; and make a ſort of ſhelter from the inclemency of the weather. They are of a grave appearance and melancholy diſpoſition, and even when young not inclined to frolic. They go erect, and are vaſtly ſwift and agile. Theſe accounts are chiefly taken from Andrew Battel, an Engliſh ſailor, who was taken priſoner 1589, and lived many years in the inner parts of Congo; his narrative is plain, and ſeems very authentic. It is preſerved in Purchas's collection. Froger * informs us, "that thoſe along the banks of the river Ganges are larger and more miſchievous than in any part of Africa: the negroes dread them, and cannot travel alone in the country without running the hazard of being attacked by theſe animals, who often preſent them with a ſtick, and force them to fight. I have heard the Portugueſe ſay, that they have often ſeen them hoiſt up young girls, about ſeven or eight years old, into trees, and that they could not be wreſted from them without a great deal of difficulty. The moſt part of the negroes imagine them to be a foreign nation come to inhabit their country, and that they do not ſpeak for fear of being compelled to work." When taken young, they are capable of being tamed, and taught to perform many menial offices. Francis Pyrard † relates, "that in the province of Sierra Leona, there is a ſpecies ſo ſtrong limbed, and ſo induſtrious, that, when properly trained and fed, they work like ſervants; that they generally walk on the two hind feet; that they pound any ſubſtances in a mortar; that they go to bring water from the river in ſmall pitchers, which they carry full on their heads. But when they arrive at the door, if the pitchers are not ſoon taken off, they allow them to fall; and when they perceive the pitchers overturned and broken, they weep and lament." Father Jarric ¶, quoted by Nieremberg, ſays the ſame thing, nearly in the ſame terms. With regard to the education of theſe animals, the teſtimony of Shoutten † accords with that of Pyrard. "They are taken (he remarks) with ſnares, taught to walk on their hind feet, and to uſe their fore feet as hands in performing different operations, as rinſing glaſſes, carrying drink round the company, turning a ſpit, &c." "I ſaw at Java (ſays Guat ‡) a very extraordinary ape. It was a female. She was very tall, and often walked erect on her hind feet. On theſe occaſions, ſhe concealed with her hands the parts which diſtinguiſh the ſex. Except the eye-brows, there was no hair on her face, which pretty much reſembled the groteſque female faces I ſaw among the Hottentots at the Cape. She made her bed very neatly every day, lay upon her ſide, and covered herſelf with the bed cloaths. When her head ached, ſhe bound it up with a handkerchief; and it was amuſing to ſee her

§ *Deſcript. Hiſtorique du Royaume de Macacar*, p. 51.

† *Voyages de Francois Pyrard*, tom. ii. p. 331.

¶ *Euſ. Nieremberg, Hiſt. Nat. Peregrin.* lib. ix. cap. 45.

† *Voyages de Guat. Shoutten aux Indes Orientales.*

‡ *Voyage de Fr. le Guat*, tom. ii. p. 96.

Simia.

her thus hooded in bed. I could relate many other little articles which appeared to me extremely ſingular. But I admired them not ſo much as the multitude; becauſe, as I knew the deſign of bringing her to Europe to be exhibited as a ſhow, I was inclined to think that ſhe had been taught many of theſe monkey tricks, which the people conſidered as being natural to the animal.—She died in our ſhip, about the latitude of the Cape of Good Hope. The figure of this ape had a very great reſemblance to that of man, &c." Gmelli Carreri tells us, that he ſaw one of theſe apes, which cried like an infant, walked upon its hind-feet, and carried a matt under its arm to lie down and ſleep upon.

Buffon's Nat. Hiſt by *Smellie*, vol. viii. p. 86.

An orang-outang which Buffon ſaw, is deſcribed by him as mild, affectionate, and good-natured. His air was melancholy, his gait grave, his movements meaſured, his diſpoſitions gentle, and very different from thoſe of other apes. He had neither the impatience of the Barbary ape, the maliciouſneſs of the baboon, nor the extravagance of the monkeys. "It may be alleged, (ſays our author), that he had the benefit of inſtruction; but the other apes which I ſhall compare with him, were educated in the ſame manner. Signs and words were alone ſufficient to make our orang-outang act; but the baboon required a cudgel, and the other apes a whip; for none of them would obey without blows. I have ſeen this animal preſent his hand to conduct the people who came to viſit him, and walk as gravely along with them as if he had formed a part of the company. I have ſeen him ſit down at table, unfold his towel, wipe his lips, uſe a ſpoon or a fork to carry the victuals to his mouth, pour his liquor into a glaſs, and make it touch that of the perſon who drank along with him. When invited to take tea, he brought a cup and a ſaucer, placed them on the table, put in ſugar, poured out the tea, and allowed it to cool before he drank it. All theſe actions he performed without any other inſtigation than the ſigns or verbal orders of his maſter, and often of his own accord. He did no injury to any perſon: he even approached company with circumſpection, and preſented himſelf as if he wanted to be careſſed. He was very fond of dainties, which every body gave him: And as his breaſt was diſeaſed, and he was afflicted with a teazing cough, this quantity of ſweetmeats undoubtedly contributed to ſhorten his life. He lived one ſummer in Paris, and died in London the following winter. He eat almoſt every thing; but preferred ripe and dried fruits to all other kinds of food. He drank a little wine; but ſpontaneouſly left it for milk, tea, or other mild liquors." This was only two feet four inches high, and was a young one. There is great poſſibility that theſe animals may vary in ſize and in colour, ſome being covered with black, others with reddiſh hairs.—They are not the ſatyrs of the ancients; which had tails (A), and were a ſpecies of monkey. Linnæus's *homo nocturnus*, an animal of this kind, is unneceſſarily ſeparated from his *ſimia ſatyrus*.

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To enable the reader to form a judgment of this animal, which has ſo great a reſemblance to man, it may not be unacceptable to quote from Buffon the differences and conformities which make him approach or recede from the human ſpecies. "He differs from man externally by the flatneſs of his noſe, by the ſhortneſs of his front, and by his chin, which is not elevated at the baſe. His ears are proportionally too large, his eyes too near each other, and the diſtance between his noſe and mouth is too great. Theſe are the only differences between the face of an orang-outang and that of a man. With regard to the body and members, the thighs are proportionally too ſhort, the arms too long, the fingers too ſmall, the palm of the hands too long and narrow, and the feet rather reſemble hands than the human foot. The male organs of generation differ not from thoſe of man, except that the prepuce has no frænum. The female organs are extremely ſimilar to thoſe of a woman." *Id.* p. 95.

"The orang-outang differs internally from the human ſpecies in the number of ribs: man has only 12, but the orang-outang has 13. The vertebræ of the neck are alſo ſhorter, the bones of the pelvis narrow, the buttocks flatter, and the orbits of the eyes ſunk deeper. He has no ſpinal proceſs on the firſt vertebra of the neck. The kidneys are rounder than thoſe of man, and the ureters have a different figure, as well as the bladder and gall-bladder, which are narrower and longer than in the human ſpecies. All the other parts of the body, head, and members, both external and internal, ſo perfectly reſemble thoſe of man, that we cannot make the compariſon without being aſtoniſhed that ſuch a ſimilarity in ſtructure and organization ſhould not produce the ſame effects. The tongue, and all the organs of ſpeech, for example, are the ſame as in man; and yet the orang-outang enjoys not the faculty of ſpeaking; the brain has the ſame figure and proportions; and yet he poſſeſſes not the power of thinking. Can there be a more evident proof than is exhibited in the orang-outang, that matter alone, though perfectly organized, can produce neither language nor thought, unleſs it be animated by a ſuperior principle? Man and the orang-outang are the only animals who have buttocks and the calf of the legs, and who, of courſe, are formed for walking erect; the only animals who have a broad cheſt, flat ſhoulders, and vertebræ of the ſame ſtructure; and the only animals whoſe brain, heart, lungs, liver, ſpleen, ſtomach, and inteſtines, are perfectly ſimilar, and who have an appendix vermiformis, or blind-gut. In fine, the orang-outang has a greater reſemblance to man than even to the baboons or monkeys, not only in all the parts we have mentioned, but in the largeneſs of the face, the figure of the cranium, of the jaws, of the teeth, and of the other bones of the head and

(A) Ælian gives them tails, *lib.* xvi. c. 21. Pliny ſays they have teeth like dogs, *lib.* vii. *c.* 2. circumſtances common to many monkeys. *Ptolemy*, *lib.* 7. *c.* 2. ſpeaks of certain iſlands in the Indian ocean inhabited by people with tails like thoſe with which ſatyrs are painted, whence called the *iſles of ſatyrs*. Kœping, a Swede, pretended to have diſcovered theſe *homines caudati*; that they would have trafficked with him, offering him live parrots; that afterwards they killed ſome of the crew that went on ſhore, and eat them, &c. &c. *Amœn. Acad.* vi. 71.

Simia.

and face; in the thickneſs of the fingers and thumb, the figure of the nails, and the number of vertebræ; and, laſtly, in the conformity of the articulations, the magnitude and figure of the rotula, ſternum, &c. Hence, as there is a greater ſimilarity between this animal and man, than between thoſe creatures which reſemble him moſt, as the Barbary ape, the baboon, and monkey, who have all been deſigned by the general name of *opes*, the Indians are to be excuſed for aſſociating him with the human ſpecies, under the denomination of *orang-outang*, or *wild man*. In fine, if there were a ſcale by which we could deſcend from human nature to that of the brutes, and if the eſſence of this nature conſiſted entirely in the form of the body, and depended on its organization, the orang-outang would approach nearer to man than any other animal. Placed in the ſecond rank of beings, he would make the other animals feel his ſuperiority, and oblige them to obey him. If the principle of imitation, by which he ſeems to mimic human actions, were a reſult of thought, this ape would be ſtill farther removed from the brutes, and have a greater affinity to man. But the interval which ſeparates them is immenſe. Mind, reflection, and language, depend not on figure or the organization of the body. Theſe are endowments peculiar to man. The orang-outang, though, as we have ſeen, he has a body, members, ſenſes, a brain, and a tongue, perfectly ſimilar to thoſe of man, neither ſpeaks nor thinks. Though he counterfeits every human movement, he performs no action that is characteriſtic of man, no action that has the ſame principle or the ſame deſign. With regard to imitation, which appears to be the moſt ſtriking character of the ape kind, and which the vulgar have attributed to him as a peculiar talent, before we decide, it is neceſſary to inquire whether this imitation be ſpontaneous or forced. Does the ape imitate us from inclination, or becauſe, without any exertion of the will, he feels the capacity of doing it? I appeal to all thoſe who have examined this animal without prejudice; and I am convinced that they will agree with me, that there is *nothing* voluntary in this imitation. The ape, having arms and hands, uſes them as we do, but without *thinking* of us. The ſimilarity of his members and organs neceſſarily produces movements, and ſometimes ſucceſſions of movements, which reſemble ours. Being endowed with the human ſtructure, the ape muſt move like man; but the ſame motions imply not that he acts from imitation. Two bodies which receive the ſame impulſe, two ſimilar pendulums or machines, will move in the ſame manner; but theſe bodies or machines can never be ſaid to imitate each other in their motions. The ape and the human body are two machines ſimilarly conſtructed, and neceſſarily move nearly in the ſame manner; but parity is not imitation. The one depends on matter, and the other on mind. Imitation preſuppoſes the deſign of imitating. The ape is incapable of forming this deſign, which requires a train of thinking; conſequently man, if he inclines, can imitate the ape; but the ape cannot even incline to imitate man."

Fig. 2. 3. Pongo, or Jocko, are conſidered as one ſpecies by Pennant and Gmelin. It inhabits the iſland of Java, and the interior parts of Guinea. Has no pouches within his cheeks, no tail, and no calloſities on the buttocks; which laſt are plump and fleſhy. All the teeth are ſimilar to thoſe of man. The face is flat, naked, and tawny; the ears, hands, feet, breaſt, and belly, are likewiſe naked; the hair of the head deſcends on both temples in the form of treſſes; the hair on the back and loins is in ſmall quantities. It is five or ſix feet high, and walks always erect on the two hind feet. It has not been aſcertained whether the females, of this ſpecies or variety, are ſubject to periodical diſcharges; but analogy renders this almoſt unqueſtionable. This animal is, by Dr Gmelin, conſidered only as a variety of the orang-outang.

Simia.

4. The great gibbon, long-armed ape, or ſimia lar, with a flat ſwarthy face ſurrounded with grey hairs: hair on the body black and rough; buttocks bare; nails on the hands flat; on the feet long; arms of a moſt diſproportioned length, reaching quite to the ground when the animal is erect, its natural poſture; of a hideous deformity.—Inhabits India, Malacca, and the Molucca iſles; a mild and gentle animal; grows to the height of four feet. The great black ape of Mangſi, a province in China, ſeems to be of this kind. Fig. 3.

5. The leſſer gibbon, or ſimia lar minor, but is much leſs, being only about a foot and a half high; the body and face are of a brown colour, reſembles the former. The ſimia lar argentea is probably a variety of this ſpecies. Fig. 4.

6. The pigmy, or ſimia ſilvanus, has no tail; the buttocks are naked; the head roundiſh, and the arms ſhorter than the body. It inhabits Africa; and is not uncommon in our exhibitions of animals; is very tractable and good-natured, and was moſt probably the pigmy of the ancients. It abounds in Æthiopia, one ſeat of that imaginary nation; was believed to dwell near the fountains of the Nile, whence it deſcended annually to make war on the cranes, *i. e.* to ſteal their eggs, which the birds may be ſuppoſed naturally to defend; whence the fiction of their combats. Fig. 5.

7. The magot, ſimia inuus, or Barbary ape, has a long face, not unlike that of a dog; canine teeth, long and ſtrong; ears like the human; nails flat; buttocks bare; colour of the upper part of the body a dirty greeniſh brown; belly, of a dull pale yellow; grows to above the length of four feet.—They inhabit many parts of India, Arabia, and all parts of Africa except Egypt, where none of this genus are found. A few are found on the hill of Gibraltar, which breed there; probably from a pair that had eſcaped from the town; as they are not found in any other part of Spain.—They are very ill-natured, miſchievous, and fierce; agreeing with the character of the ancient Cynocephali. They are a very common kind in exhibitions. By force of diſcipline they are made to play ſome tricks; otherwiſe they are more dull and ſullen than the reſt of this genus. They aſſemble in great troops in the open fields in India, and will attack women going to market, and take their proviſions from them. The females carry the young in their arms, and will leap from tree to tree with them. Apes were worſhipped in India, and had magnificent temples erected to them. When the Portugueſe plundered one in Ceylon, they found in a little golden caſket the tooth of an ape; a relic held by the natives in ſuch veneration, that they offered 700,000 ducats to redeem it, but in vain; for it was burnt by the viceroy, to ſtop the progreſs of idolatry. Fig. 6. and 7.

II. PAPIONES, or BABOONS. Theſe have ſhort tails, a long face; a broad high muzzle; longiſh dog-like tuſks, or canine teeth; and naked calloſities on the buttocks. They are only found in the old world, and are the papiones and Κυνοκεφαλα of the ancients.

8. The maimon, ſimia papio nemeſtrina, or pig-tailed baboon, Plate CCCCLXVIII. fig. 8.

Simia. baboon, with a pointed face, which is naked, of a swarthy redness; two sharp canine teeth; ears like the human; hair on the limbs and body brown inclining to ash-colour, palest on the belly; fingers black; nails long and flat; thumbs on the hind-feet very long, connected to the nearest toe by a broad membrane; tail four inches long, slender, exactly like a pig's, and almost naked; the bare spaces on the rump red, and but small: length, from head to tail, 22 inches. Inhabits the isles of Sumatra and Japan; is very docile. In Japan it is taught several tricks, and carried about the country by mountebanks. Kempfer was informed by one of these people, that the baboon he had was 102 years old.

Fig. 9. 9. The great baboon, or simia papio sphinx, with hazel irides; ears small and naked; face canine, and very thick; middle of the face and fore-head naked; and of a bright vermilion colour; tip of the nose of the same, and ending truncated like that of a hog; sides of the nose broadly ribbed, and of a fine violet hue; the opening of the mouth very small; cheeks, throat, and goat-like beard yellow; hair on the fore-head very long, turns back, is black, and forms a kind of pointed crest. Head, arms, and legs, covered with short hair, yellow and black intermixed; the breast with long whitish yellow hairs, the shoulders with long brown hair. Nails flat; feet and hands black; tail four inches long, and very hairy; buttocks bare, red, and filthy; but the space about them is of a most elegant purple colour, which reaches to the inside of the upper part of the thighs.

Pennant's Quadrupeds, vol. i. p. 172. This was described by Mr Pennant from a stuffed specimen in Sir Ashton Lever's museum. In August 1779, a live animal of this species was shown at Edinburgh, and in October following at Chester, where being seen by Mr Pennant, that inquisitive naturalist has described it in his History of Quadrupeds. "It differed little (he observes) in colour from the above, being in general much darker. Eyes much sunk in the head, and small. On the internal side of each ear was a white line, pointing upwards. The hair on the fore-head turned up a like a toupee. Feet black; in other respects resembled the former. In this I had an opportunity of examining the teeth. The cutting teeth were like those of the rest of the genus; but, in the upper and lower jaw, were two canine, or rather tusks, near three inches long, and exceedingly sharp and pointed. This animal was five feet high, of a most tremendous strength in all its parts; was excessively fierce, libidinous, and strong."

Mr Schreber says, that this species lives on succulent fruits, and on nuts; is very fond of eggs, and will put eight at once into its pouches, and, taking them out one by one, break them at the end, and swallow the yolk and white; rejects all flesh-meat, unless it be dressed; would drink quantities of wine or brandy; was less agile than other baboons; very cleanly; for it would immediately fling its excrements out of its hut. That which was shown at Chester was particularly fond of cheese. Its voice was a kind of roar, not unlike that of a lion, but low and somewhat inward. It went upon all fours, and never stood on its hind legs, unless forced by the keeper; but would frequently sit on its rump in a crouching manner, and drop its arms before the belly. Inhabits the hotter parts of Africa.

Fig. 10. 10. The little baboon, or simia papio apedia, has a roundish head, with a projecting muzzle, and roundish naked ears; the hair on the body is yellow, tipt with black; the face is brown, and almost naked, having only a few scattered hairs; the nails are all compressed and oblong, except on the thumbs and great toes, the nails of which resemble man; the tail is very short, being hardly an inch long; the body is about the size of a cat. It is uncertain, says Gmelin, if this animal should be considered as a distinct species, or only as a variety of the simia sciurea. Simai.

Fig. 11. 11. The mantegar, or simia papio mermon, commonly called the *tufted ape*, but it is improperly named an *ape*, as it has a tail. It is described in the abridgment of the Philosophical Transactions, nº 290. It had a nose and head 14 inches in length; the nose of a deep red, face blue, both naked; black eye-brows; ears like the human; on the top of the head a long upright tuft of hair; on the chin another; two long tusks in the upper jaw; fore feet exactly resembling hands, and the nails on the fingers flat; the fore-part of the body, and the inside of the legs and arms, naked; the outside covered with mottled brown and olive hair. Length, from the nose to the rump, three feet two inches. It was very fierce and salacious; went on all fours, but would sit up on its rump, and support itself with a stick; in this attitude, it would hold a cup in its hand, and drink out of it. Its food was fruits.

Fig. 12. and 13. 12. The mandril, simia papio maimon, or ribbed nose baboon, has a short tail, and a thin beard on the chin; the cheeks are blue and striped, and the buttocks are naked. This species of baboon is found on the Gold Coast, and in the other southern provinces of Africa, where he is called *boggo* by the negroes, and *mandril* by the Europeans. Next to the orang-outang, he is the largest of all the apes or baboons. Smith relates, that he had a present of a female mandril, which was only six months old, and that it was as large as an adult baboon. He adds, that these mandrils walk always on two feet; that they weep and groan like men; that they have a violent passion for women, which they never fail to gratify when they find a woman at a distance from relief. We have given figures both of the male and female, which may be easily distinguished by their size and appearance.

Fig. 14. 13. The wood-baboon, or simia papio sylvatica, with a long dog-like face, covered with a small glossy black skin; hands and feet naked, and black like the face; hair on all parts long, elegantly mottled with black and tawny; nails white: about three feet high when erect; tail not three inches, and very hairy on the upper top. Inhabits Guinea, where it is called by the English the *man of the wood*.

14. The brown baboon, or simia papio platypygos, with pointed ears; face of a dirty white; nose large and broad; hairs round the face short and straight; colour of the upper part of the body brown; of the under, ash-colour: tail about four inches long; taper, and almost bare of hair; beneath is quite naked. The animal which Mr Pennant called the *new baboon*, in the first edition, seems by the taperness of the tail, and general form, to be of this kind.

15. The hoggish baboon, or simia papio porcaria, has a short tail, and coloured buttocks; the head is like that of a hog, with a naked snout; the body is of an olive brown colour; the nails are sharp and compressed. Inhabits Africa, and is about three feet and a half high when

Simia. when ſtanding erect. This, in all probability, is the ſame animal with the hog-faced ape, adopted from Pennant.

III. Monkeys, Cercopitheci, have long tails, which are not prehenſile; the under parts of their cheeks are furniſhed with pouches, in which they can keep their victuals; the partition between the noſtrils is thin, and the apertures are, like thoſe of man, placed in the under part of the noſe; the buttocks are naked, and provided with calloſities. Theſe animals, which are never found native in America, are the cercopitheci, and Κυβοι, of the ancients.

Plate ccccLxix. Fig. 15. 16. The Tartarin, dog-faced baboon of Pennant, and cercopithecus hamadryas of Gmelin, with a long, thick, and ſtrong noſe, covered with a ſmooth red ſkin; ears pointed, and hid in the hair; head great, and flat; hair on the head, and fore-part of the body as far as the waiſt, very long and ſhaggy; grey and olive-brinded; the ſides of the head very full, the hair on the limbs and hind-part of the body very ſhort; limbs ſtrong and thick; hands and feet duſky; the nails on the fore-feet flat; thoſe on the hind like a dog's; buttocks very bare, and covered with a ſkin of a bloody colour; tail ſcarce the length of the body, and carried generally erect. They inhabit the hotteſt parts of Africa and Aſia; where they keep in vaſt troops, and are very fierce and dangerous. They rob gardens. They will run up trees when paſſengers go by, ſhake the boughs at them with great fury, and chatter very loud. They are exceſſively impudent, indecent, laſcivious; moſt deteſtable animals in their manners as well as appearance. They range the woods in hundreds; which obliges the owners of the coffee-plantations to be continually on their guard againſt their depredations. One of them was ſhown in London ſome years ago: it came from Mokha, in the province of Yeman, in Arabia Felix in the Perſian gulph; and was above five feet high. It was very fierce and untameable; ſo ſtrong as eaſily to maſter its keeper, a ſtout young man. Its inclinations to women appeared in the moſt violent manner. A footman, who brought a girl to ſee it, in order to teaze the animal, kiſſed and hugged her: the beaſt, enraged at being ſo tantalized, caught hold of a quart pewter-pot, which he threw with ſuch force and ſo ſure an aim, that, had not the man's hat and wig ſoftened the blow, his ſkull muſt have been fractured; but he fortunately eſcaped with a common broken head.

Fig. 16. 17. The white-bearded black wanderu, the ſimia ſilenus of Linnæus, the ouanderou of Buffon, and lion-tailed baboon of Pennant, the cercopithecus ſilenus albibarbatus of Gmelin, has a dog-like face, is naked, and of a duſky colour; a very large and full white or hoary beard; large canine teeth; body covered with black hair; belly of a light colour; tail terminated with a tuft of hair like that of a lion. Its bulk that of a middling ſized dog. It inhabits the Eaſt Indies and the hotter parts of Africa.

18. The purple-faced monkey, or cercopithecus ſilenus purpuratus, with a great triangular white beard, ſhort and pointed at the bottom, and on each ſide of the ears, extending a winged faſhion far beyond them; face and hands purple, body black. Inhabit Ceylon. They are very harmleſs; live in the woods, and feed on leaves and buds of trees; and when taken ſoon become tame.

19. Malbrouk, or cercopithecus faunus, has a long tail, and is bearded; the tail is buſhy at the extremity. It is a native of Bengal. This ſpecies has cheek-pouches, and calloſities on the buttocks; the tail is nearly as long as the body and head; and it is a miſtake of Cluſius that it terminates in a tuft; the face is of a cinereous grey colour, with a large muzzle, and large eyes, which have fleſh-coloured eyelids, and a grey band croſs the forehead in the place of eye-brows; the ears are large, thin, and fleſh-coloured; the upper parts of the body are of a uniform yellowiſh brown colour, and the lower of a yellowiſh grey: It walks on all fours, and is about a foot and a half from the muzzle to the extremity of the tail. The females menſtruate.

20. Macaque, or cercopithecus cynomologus, the hare-lipped monkey of Pennant, has no beard; the noſtrils are thick and divided; the tail is long and arched, and the buttocks are naked. He has cheek-pouches and calloſities on the buttocks. His tail is from 18 to 20 inches long. His head is large, his muzzle very thick, and his face naked, livid, and wrinkled. His ears are covered with hair. His body is ſhort and ſquat, and his limbs thick and ſhort. The hair on the ſuperior parts of his body is of a greeniſh aſh-colour, and of a yellowiſh grey on the breaſt and belly. He has a ſmall creſt of hair on the top of the head. He walks on four and ſometimes on two feet. The length of his body, comprehending that of the head, is about 18 or 20 inches.

21. The dog-headed monkey, or cercopithecus cynocephalus, has no beard, and is of a yellow colour; the muzzle is long; the tail long and ſtraight, and the buttocks naked. It is a native of Africa.

22. The ſpotted monkey, or cercopithecus Diana, with a long white beard: colour of the upper parts of the body reddiſh, as if they had been finged, marked with white ſpecks; the belly and chin whitiſh; tail very long; is a ſpecies of a middle ſize. It inhabits Guinea and Congo, according to Marcgrave; the Congeſe call it *exquima*. M. de Buffon denies it to be of that country; but from the circumſtance of the curl in its tail, in Marcgrave's figure, and the deſcription of ſome voyagers, he ſuppoſes it to be a native of South America. Linnæus deſcribes his S. Diana ſomewhat differently: he ſays it is of the ſize of a large cat; black, ſpotted with white; hind part of the back ferruginous; face black; from the top of the noſe is a white line paſſing over each eye to the ears, in an arched form; beard pointed, black above, white beneath, placed on a fattiſh excreſcence; breaſt and throat white; from the rump, croſs the thighs, a white line; tail long, ſtraight, and black; ears and feet of the ſame colour; canine teeth, large.

23. The green monkey, or cercopithecus ſabœus, has a black and flattiſh face: the ſide of it bounded by long white hairs, falling backwards, and almoſt covering the ears, which are black, and like the human: head, limbs, and whole upper part of the body and tail covered with ſoft hair, of a yellowiſh green colour at their ends, cinereous at their roots: under ſide of the body and tail, and inner ſide of the limbs, of a ſilvery colour: tail very long and ſlender. Size of a ſmall cat. Inhabit different parts of Africa: keep in great flocks, and live in the woods: are ſcarce diſcernible when among the leaves, except by their breaking the boughs with their

Simia. gambols: in which they are very agile and ſilent: even when ſhot at, do not make the leaſt noiſe: but will unite in company, knit their brows, and gnaſh their teeth, as if they meant to attack the enemy: are very common in the Cape de Verd iſlands.

24. The muſtache, or cercopithecus cephus, has a beard on the cheeks; the crown of the head is yellowiſh: the feet are black, and the tip of the tail is of an aſh colour. Its tail is much longer than the body and head, being 19 or 20 inches in length. The female menſtruates.

Fig. 20. 25. The mangabey, cercopithecus æthiops, or white-eyed monkey, has a long, black, naked, and dog-like face: the upper eye-lids of a pure white: ears black, and like the human: no canine teeth: hairs on the ſides of the face beneath the cheeks, longer than the reſt: tail long: colour of the whole body tawny and black: flat nails on the thumbs and fore-fingers; blunt claws on the others: hands and feet black —Shown in London ſome years ago: place uncertain: that deſcribed by M. de Buffon came from Madagaſcar; was very good-natured; went on all-fours.

Fig. 21. 26. The egret, or cercopithecus aygula, has a long face, and an upright ſharp-pointed tuft of hair on the top of the head. The hair on the forehead is black: the tuft, and the upper part of the body light-grey; the belly white: the eye-brows are large; the beard very ſmall. Size of a ſmall cat. They inhabit Java. They fawn on men, on their own ſpecies, and embrace each other. They play with dogs, if they have none of their own ſpecies with them. If they ſee a monkey of another kind, they greet him with a thouſand grimaces. When a number of them ſleep, they put their heads together. They make a continual noiſe during night.

27. The rillow, cercopithecus ſinicus, or Chineſe bonnet, has a long ſmooth noſe, of a whitiſh colour; hair on the crown of the head long, lying flat, and parted like that of a man; colour, a pale cinereous brown, Inhabit Ceylon. They keep in great troops; and rob gardens of their fruit, and fields of their corn; to prevent which, the natives are obliged to watch the whole day: yet theſe animals are ſo bold, that, when driven from one end of the field, they will immediately enter at the other, and carry off with them as much as their mouth and arms can hold. Boſman, ſpeaking of the thefts of the monkeys of Guinea, ſays, that they will take in each paw one or two ſtalks of millet, as many under their arms, and two or three in their mouth; and thus laden, hop away on their hind-legs: but, if purſued, they fling away all, except what is in their mouths, that it may not impede their flight. They are very nice in the choice of the millet; examine every ſtalk: and if they do not like it, fling it away: ſo that this delicacy does more harm to the fields than their thievery.

Ker's Tranſlation of Gmelin's Linnæus. 28. The tawny monkey, or cercopithecus fulvus, has long tuſks in the lower jaw: the viſage is long and fleſh coloured, with fleſh coloured ears, and a flattiſh noſe. Inhabits India. This is a very ill natnred animal, about the ſize of a cat; it was lately in the poſſeſſion of Mr Brook, an animal merchant and exhibitor in London: The upper parts of the body are covered with a pale tawny coloured fur, which is aſh coloured at the roots; the hinder part of the back is orange coloured, the legs aſh coloured, the belly white, and the tail ſhorter than the body. Simia.

Fig. 22. 29. King monkey, full-bottom monkey, or cercopithecus regalis, has no thumb on the hands; the head, cheeks, throat, and ſhoulders, are covered with long, flowing, coarſe hairs. Inhabits the foreſts of Sierra Leona in Guinea, where it is called *bey*, or *king monkey*. It is above three feet high when erect: The head is ſmall, with a ſhort, black, naked face; and the head, cheeks, throat, neck, and ſhoulders, are covered with long, coarſe, flowing hairs, of a dirty yellowiſh colour, mixed with black, and reſembling a full-bottomed wig; the body, arms, and legs, are covered with ſhort hairs of a fine gloſſy black colour; the hands are naked, and have no thumbs; the feet have five very long ſlender toes, which are armed with narrow pointed claws; the tail is very long, and is covered with ſnow white hairs, having a tuft at the end; the body and limbs are very ſlender: Its ſkin is held in high eſtimation by the negroes for making pouches and gun caſes.

IV. Sapajous, Sapaji, have prehenſile tails, and no cheek-pouches. Theſe animals have long tails, which, at the extremity, is generally deprived of hair on the under ſide, and covered with a ſmooth ſkin; this part they can fold, extend, curl up, and unfold at pleaſure; by which they are enabled to hang upon branches, or to lay hold of any thing which is beyond the reach of their hands, uſing the extremity of the tail like a finger or hand; the partition between the noſtrils is very thick, and the apertures are ſituated on the ſides of the noſe; the buttocks are clothed with hair, and have no calloſities; the females of this ſubgenus do not menſtruate; and this race of animals is only to be found in America: This ſubdiviſion of the genus is made with great propriety by Dr Gmelin, in imitation of the Count de Buffon.

Plate CCCCLXX. Fig. 23. 30. The guariba, ſapajus Beelzebub, or the preacher monkey, has black ſhining eyes; ſhort round ears; and a round beard under the chin and throat. The hairs on the body are of a ſhining black, long, yet lie ſo cloſe on each other that the animal appears quite ſmooth: the feet and end of the tail are brown; the tail very long, and always twiſted at the end. Size of a fox. Inhabit the woods of Brazil and Guiana in vaſt numbers, and make a moſt dreadful howling. Sometimes one mounts on a higher branch, the reſt ſeat themſelves beneath; the firſt begins as if it was to harangue, and ſets up ſo loud and ſharp a howl as may be heard a vaſt way, and a perſon at a diſtance would think that a hundred joined in the cry: after a certain ſpace, he gives a ſignal with his hand, when the whole aſſembly joins in chorus; but on another ſignal is ſilent, and the orator finiſhes his addreſs (B). Their clamour is the moſt diſagreeable and tremendous that can be conceived; owing to a hollow and hard bone placed in the throat, which

(B) A ſingular account, yet related by Marcgrave and ſeveral other writers. Marcgrave is a writer of the firſt authority, and a moſt able naturaliſt, long reſident in the Braſils, and ſpeaks from his own knowledge.

Simia. which the Engliſh call the *throttle-bone*. Theſe monkeys are very fierce, untameable, and bite dreadfully. There is a variety of a ferruginous or reddiſh bay colour, which the Indians call the *king of the monkeys*: it is large, and as noiſy as the former. The natives eat this ſpecies, as well as ſeveral other ſorts of monkeys, but are particularly fond of this. Europeans will alſo eat it, eſpecially in thoſe parts of America where food is ſcarce: when it is ſcalded in order to get off the hair, it looks very white; and has a reſemblance ſhocking to humanity, that of a child of two or three years old when crying (c).

31. The quato, ſapajus paniſcus, or four-fingered monkey, has a long flat face, of a ſwarthy fleſh colour: the eyes are ſunk in the head; ears like the human; limbs of a great length, and uncommonly ſlender: the hair is black, long, and rough. There are only four fingers on the hands, being quite deſtitute of a thumb; five toes on the feet. The tail is long; and naked below, near the end. The body is ſlender; about a foot and a half long; the tail near two feet, and ſo prehenſile as to ſerve every purpoſe of a hand. They inhabit the neighbourhood of Carthagena, Guiana, Braſil, and Peru; aſſociate in vaſt herds; and are ſcarce ever ſeen on the ground. Dampier deſcribes their gambols in a lively manner: "There was (ſays he) a great company dancing from tree to tree over my head, chattering, and making a terrible noiſe and a great many grim faces and antic geſtures; ſome broke down dry ſticks and flung them at me, others ſcattered their urine and dung about my ears: at laſt one bigger than the reſt came to a ſmall limb juſt over my head, and leaping directly at me, made me leap back; but the monkey caught hold of the bough with the tip of its tail, and there continued ſwinging to and fro, making mouths at me. The females with their young ones are much troubled to leap after the males; for they have commonly two, one ſhe carries under her arm, the other ſits on her back, and claps its two fore-paws about her neck: are very ſullen when taken; and very hard to be got when ſhot, for they will cling with their tail or feet to a bough as long as any life remains. When I have ſhot at one, and broke a leg or arm, I have pitied the poor creature to ſee it look and handle the broken limb, and turn it from ſide to ſide."—They are the moſt active of monkeys, and quite enliven the foreſts of America. In order to paſs from top to top of lofty trees, whoſe branches are too diſtant for a leap, they will form a chain, by hanging down, linked to each other by their tails, and ſwinging in that manner till the loweſt catches hold of a bough of the next tree, and draws up the reſt; and ſometimes they paſs rivers by the ſame expedient. They are ſometimes brought to Europe; but are very tender, and ſeldom live long in our climate.

Fig. 24. 32. The ſai, ſapajus, capucinus, or weeper, with a round and flat face, of a reddiſh brown colour, very deformed: the hair on the head and upper part of the body black, tinged with brown; beneath and on the limbs tinged with red: tail black, and much longer than the head and body: the young exceſſively deformed; their hair very long, and thinly diſperſed.—In the Britiſh Muſeum are ſpecimens of old and young. M. de Büffon has a variety with a white throat. Inhabits Surinam and Braſil: appear as if it was always weeping; of a melancholy diſpoſition; but, very full of imitating what it ſees done. Theſe probably are the monkeys Dampier ſaw in the Bay of All Saints, which he ſays are very ugly, and ſmell ſtrongly of muſk. They keep in large companies; and make a great chattering, eſpecially in ſtormy weather; reſide much on a ſpecies of tree which bears a podded fruit, which they feed on.

Simia.

33. Sapajus fatuellas, or horned ſapajou, has two tufts of hair on the head, reſembling little horns: Is beardleſs. Inhabits South America. The face, ſides, belly, and fore-parts of the thighs are brown; the top of the head, middle of the back, tail, legs, and poſterior parts of the thighs, are black; the nails are long and rather blunt; the tail is prehenſile and twiſted ſpirally. Perhaps of the ſame ſpecies with the ſimia apella or capuchin (*Gm.*). This, in all probability, is one of the factitious ſpecies, purpoſely deformed, by exhibitors of wild beaſts, to impoſe on the public. Fig. 25.

34. Saimiri, ſapajus ſciureus, or orange monkey, has no beard; the hinder part of the head is prominent; and the nails on the four toes of the hind paws are narrow and pointed. It inhabits South America, and is the moſt beautiful of all the ſapajous; its movements are graceful; its ſize ſmall; its colour a brilliant yellow; its viſage round, with large vivacious eyes, ſurrounded by fleſh-coloured rings; it has hardly any forehead; the noſe is elevated at the baſe, and flattened at the point: the mouth is ſmall, the face flat and naked, and the ears are garniſhed with hair, and a little pointed; the tail is only half prehenſile: It ſtands with eaſe on two feet, but commonly walks on all four.

V. Sagoins, Sagoini. Theſe have long tails, which are proportionally longer than thoſe of the ſapajous, ſtraight, flaccid, entirely covered with hair, and not prehenſile; that is, incapable of laying hold of any object: the cheeks have no pouches; and the buttocks, which are covered with hair, have no calloſities: the partition between the noſtrils is very thick, and the apertures are placed on the ſides of the noſe. The females do not menſtruate. This race of animals is only found in America. *Ker's Tranſlation of Gmelin's Linnæus.*

35. The ſaki, ſagoinus pithecia, or fox-tailed monkey, with a ſwarthy face, covered with ſhort white down: forehead and ſides of the face with whitiſh, and pretty long hair: body with long duſky brown hairs; white or yellowiſh at their tips: hair on the tail very long and buſhy; ſometimes black, ſometimes reddiſh: belly and lower part of the limbs a reddiſh white: length from noſe to tail near a foot and a half: tail longer, and like that of a fox: hands and feet black, with claws inſtead of nails. Inhabits Guiana.

36. The ſanglin, ſagoinus iacchus, or ſtriated monkey, Fig. 26.

(c) *Ulloa's Voy.* I. 113. *Des Marchais*, III. 311. ſays, they are excellent eating, and that a *ſoupe aux ſinges* will be found as good as any other, as ſoon as you have conquered the averſion to the *bouilli* of their heads, which look very like thoſe of little children.

Simia. key, with a very round head: about the ears two very long full tufts of white hairs ſtanding out on each ſide: irides reddiſh: face a ſwarthy fleſh colour: ears like the human: head black: body aſh coloured, reddiſh, and duſky; the laſt forms ſtriated bars croſs the body: tail full of hair, annulated with aſh colour and black: body ſeven inches long; tail near eleven: hands and feet covered with ſhort hairs: fingers like thoſe of a ſquirrel: nails, or rather claws, ſharp. Inhabits Braſil: feeds on vegetables; will alſo eat fiſh: makes a weak noiſe: very reſtleſs: often brought over to Europe.

Fig. 27. 37. Pinche, ſagoinus œdipus, or red-tailed monkey, is beardleſs; has a flowing head of hair, which hangs down on each ſide; a red tail and ſharp claws. It has neither cheek-pouches nor calloſities on the buttocks. His tail is not prehenſile, and is more than twice the length of the head and body. The partition of the noſtrils is thick, and the apertures are placed at a ſide. The face, throat, and ears are black; on the head are long white hairs. The muzzle is broad, and the face round. The hair on the body is pretty long; of a yelloweiſh brown or reddiſh colour till near the tail, where it becomes orange; on the breaſt, belly, hands, and feet, it is white, and ſhorter than on the body. The tail, from the origin to one-half of its length, is a vivid red, then browniſh red, and toward the point it is black. He is about nine inches in length, and walks on four feet. The females are not ſubject to the menſtrual evacuation.

Fig. 28. 38. The marikina, ſagoinus roſalius, or ſilky monkey, is beardleſs; has a very hairy head: the circumference of the face and the feet are red; and the claws are ſharp and narrow. It inhabits South America. A briſk animal, leſs impatient of cold than the reſt of this race: the body is of a yellowiſh white colour; the nails on the thumbs and great toes are rounded; the ears are naked, but are hidden beneath the fur: It has a round head, and a brown face, which is ſurrounded with a kind of mane of a bright red colour; the hair on the body and tail is long, ſilky, and of a pale but vivid yellow colour, almoſt white, with a conſiderable tuft at the extremity of the tail. It walks on four feet, and is eight or nine inches in length, from the muzzle to the rump; and the tail is above 13 inches long. This ſpecies has the ſame manners and vivacity with the other ſagoins, but is more robuſt in conſtitution, as an individual lived five or ſix years in Paris, being kept in a warm room during winter.

39. The mico, ſagoinus argenteus, or fair monkey, with a ſmall round head: face and ears of the moſt lively vermilion colour: body covered with moſt beautiful long hairs of a bright and ſilvery whiteneſs, of matchleſs elegance: tail of a ſhining dark cheſnut: head and body eight inches long; tail 12. Inhabits the banks of the Amazons; diſcovered by M. de Condamine.

Fig. 29. 40. The tamarin, ſagoinus Midas, or great-eared monkey, with a round head, ſwarthy, fleſh coloured, naked face: upper lip a little divided: ears very large, erect, naked, and almoſt ſquare: hair on the forehead upright and long; on the body ſoft, but ſhaggy: the head, whole body, and upper part of the limbs black, except the lower part of the back, which is tinged with yellow: hands and feet covered with orange-coloured hairs, very fine and ſmooth: nails long and crooked: tail black, and twice the length of the body: teeth very white. It is of the ſize of a ſquirrel. It inhabits the hotter parts of South America, and the iſle of Gorgona, ſouth of Panama, in the South Sea. There are, ſays Dampier, a great many little black monkeys: at low-water they come to the ſea-ſide to take muſcles and perriwinkles, which they dig out of the ſhells with their claws. Simile || Simon.

Beſides theſe which we have deſcribed, there are a great many ſpecies which we have omitted. Thoſe who wiſh to be better acquainted with the ſimiæ, may conſult Buffon, Pennant, and Gmelin's edition of the Zoology of Linnæus by Mr Ker.

SIMILE, or Similitude, in rhetoric, a compariſon of two things, which though different in other reſpects, yet agree in ſome one. The difference between a ſimile and compariſon is ſaid to conſiſt in this, that the ſimile properly belongs to whatever we call the quality of a thing, and the compariſon to the quantity. See Comparison; and Oratory, n° 118.

SIMILOR, a name given to an alloy of red copper and zinc, made in the beſt proportions, to imitate ſilver and gold.

SIMON Maccabeus, a celebrated leader and high-prieſt of the Jews, who, after rendering the moſt important ſervices to his country, was at laſt treacherouſly ſlain by his ſon-in-law. See *the Hiſtory of the Jews*, n° 15.

Simon Magus, or the Sorcerer, was a native of Gitton, a village of Samaria. According to the uſual practice of the Aſiatics of that age, he viſited Egypt, and there probably became acquainted with the ſublime myſteries taught in the Alexandrian ſchool, and learned thoſe theurgic or magical operations by means of which it was believed that men might be delivered from the power of evil demons Upon his return into his own country, the author of the Clementine Recognitions relates, that he impoſed upon his countrymen by high pretenſions to ſupernatural powers. And St Luke atteſts, that this artful fanatic, uſing ſorcery, had bewitched the people of Samaria, giving out that he was *ſome great one;* and that he obtained ſuch general attention and reverence in Samaria, that the people all gave heed to him from the leaſt to the greateſt, ſaying, "This man is the great power of God." *Enfield's Hiſtory of Philoſophy*, vol. ii. p. 161.

By the preaching of Philip the Deacon, he was with other Samaritans converted to the Chriſtian faith, and admitted into the infant church by the ordinance of baptiſm. His converſion, however, ſeems not to have been real; for, upon ſeeing the miraculous effects of the laying on of the apoſtle's hands, he offered them money, ſaying, "Give me alſo this power, that on whomſoever I lay hands he may receive the Holy Ghoſt." He probably thought Peter and John magicians like himſelf, but better ſkilled in the art of deceiving the multitude.

Being ſharply reproved for this impiety, he ſeems by his anſwer to have been made ſenſible of his ſin; but his repentance, if ſincere, was of ſhort duration. Returning to his former practices of impoſture, he travelled through various provinces of the empire, oppoſing the progreſs of the goſpel; and arriving at Rome, he led aſtray vaſt numbers of people by his pretended miracles. How long he lived in that metropolis of the world, or in what manner he died, we have no accounts

Simon. that can be fully depended on. The Chriſtian writers tell us, that being raiſed in the air by two dæmons, he was deprived of their ſupport by the prayers of St Peter and St Paul, and falling, broke his legs. By ſome he is thought to have been the perſon mentioned by Suetonius, who, undertaking to fly in the preſence of Nero, fell to the ground with ſuch violence, that his blood ſpurted up to the gallery where the emperor was ſitting.

The ſum of this impoſtor's doctrine, diveſted of allegory, was, that from the Divine Being, as a fountain of light, flow various orders of æons, or eternal natures, ſubſiſting within the plenitude of the divine eſſence; that beyond theſe, in the order of emanation, are different claſſes of intelligences, among the loweſt of which are human ſouls; that matter is the moſt remote production of the emanative power, which, on account of its infinite diſtance from the Fountain of Light, poſſeſſes ſluggiſh and malignant qualities, which oppoſe the divine operations, and are the cauſe of evil; that it is the great deſign of philoſophy to deliver the ſoul from its impriſonment in matter, and reſtore it to that divine light from which it was derived; and that for this purpoſe God had ſent him one of the firſt æons among men. To his wife Helena he alſo aſcribed a ſimilar kind of divine nature, pretending that a female æon inhabited the body of this woman, to whom he gave the name of Ενοια, *Wiſdom*; whence ſome Chriſtian fathers have ſaid, that he called her the *Holy Spirit*. He alſo taught the tranſmigration of ſouls, and denied the reſurrection of the body.

Simon (Richard), was born at Dieppe the 15th May 1638. He began his ſtudies among the prieſts of the Oratory in that city, but quitted their ſociety in a ſhort time. From Dieppe he went to Paris, where he made great progreſs in the ſtudy of the oriental languages. Some time afterwards he joined the ſociety of the Oratory again, and became a prieſt of it in 1660. In 1670 he publiſhed ſome pieces of a ſmaller kind. In 1678 his Critical Hiſtory of the Old Teſtament appeared, but was immediately ſuppreſſed by the intrigues of Meſſieurs du Port Royal. It was reprinted the year after, and its excellence ſoon drew the attention of foreigners; an edition of it was accordingly publiſhed at Amſterdam in Latin, and at London in Engliſh.

He died at Dieppe in 1712, at the age of 74.

He certainly poſſeſſed a vaſt deal of learning: his criticiſm is exact, but not always moderate; and there reigns in his writings a ſpirit of novelty and ſingularity which raiſed him a great many adverſaries. The moſt celebrated of theſe were Le Clerc, Voſſius, Jurieu, Du Pin, and Boſſuet. Simon wrote an anſwer to moſt of the books that were publiſhed againſt him, and diſplays a pride and obſtinacy in his controverſial writings which do him little honour.

He was the author of a great many books. The following are the principal: 1. The Ceremonies of the Jews, tranſlated from the Italian of Leo of Modena, with a ſupplement concerning the ſects of the Barraites and Samaritans. 2. *L'Hiſtoire Critique du Vieux Teſtament*, "The Critical Hiſtory of the Old Teſtament." This is a very important work, and deſerves the attention of every clergyman. He ſometimes, however, deviates from the road of integrity, to ſerve the cauſe of the church of Rome, particularly in his endeavours to prove the uncertainty of the Hebrew language. Theſe paſſages have been very juſtly expoſed and confuted by Dr Campbell, in his ingenious Preliminary Diſſertations to his new Tranſlation of the Goſpels. 3. Critical Hiſtory of the Text of the New Teſtament. 4. Critical Hiſtory of the Verſions of the New Teſtament. 5. Critical Hiſtory of the principal Commentators on the New Teſtament. 6. Inſpiration of the Sacred Books. 7. A tranſlation of the New Teſtament. This book was cenſured by Cardinal Noailles and Boſſuet. 8. The Hiſtory of the riſe and progreſs of Eccleſiaſtical Revenues, which is commended by Voltaire, as is his Critical Hiſtory of the Old Teſtament. It reſulted from a quarrel with a community of Benedictines. 9. A new ſelect Library, which points out the good books in various kinds of literature, and the uſe to be made of them. 10. Critical Hiſtory of the Belief and Cuſtoms of the Nations on the Levant. 11. Critical Letters, &c.

Simonical, Simonides. SIMONICAL, is applied to any perſon guilty of ſimony. See Simony.

SIMONIDES, the name of ſeveral poets celebrated in antiquity; but by the Marbles it appears that the eldeſt and moſt illuſtrious of them was born in the 55th Olympiad, 538 years B. C. and that he died in his 90th year; which nearly agrees with the chronology of Euſebius. He was a native of Ceos, one of the Cyclades, in the neighbourhood of Attica, and the preceptor of Pindar. Both Plato and Cicero give him the character not only of a good poet and muſician, but ſpeak of him as a perſon of great virtue and wiſdom. Such longevity gave him an opportunity of knowing a great number of the firſt characters in antiquity with whom he was in ſome meaſure connected. It appears in Fabricius, from ancient authority, that Simonides was cotemporary and in friendſhip with Pittacus of Mitylene, Hipparchus tyrant of Athens, Pauſanias king of Sparta, Hiero tyrant of Syracuſe, with Themiſtocles, and with Alevades king of Theſſaly. He is mentioned by Herodotus; and Xenophon, in his Dialogue upon Tyranny, makes him one of the interlocutors with Hiero king of Syracuſe. Cicero alleges, what has often been quoted in proof of the modeſty and wiſdom of Simonides, that when Hiero aſked him for a definition of God, the poet required a whole day to meditate on ſo important a queſtion: at the end of which, upon the prince putting the ſame queſtion to him a ſecond time, he aſked two days reſpite; and in this manner always doubled the delay each time he was required to anſwer it; till at length, to avoid offending his patron by more diſappointments, he frankly confeſſed that he found the queſtion ſo difficult, that the more he meditated upon it, the leſs was his hope of being able to ſolve it.

In his old age, perhaps from ſeeing the reſpect which money procured to ſuch as had loſt the charms of youth and the power of attaching mankind by other means, he became ſomewhat mercenary and avaricious. He was frequently employed by the victors at the games to write panegyrics and odes in their praiſe, before his pupil Pindar had exerciſed his talents in their behalf: but Simonides would never gratify their vanity in this particular, till he had firſt tied them down to a ſtipulated ſum for his trouble; and upon being upbraided for his

mean-

Simonides, Simony.

meanneſs, he ſaid, that he had two coffers, in one of which he had for many years put his pecuniary rewards; the other was for honours, verbal thanks, and promiſes; that the firſt was pretty well filled, but the laſt remained always empty. And he made no ſcruple to confeſs, in his old age, that of all the enjoyments of life, the love of money was the only one of which time had not deprived him.

He was frequently reproached for this vice; however, he always defended himſelf with good humour. Upon being aſked by Hiero's queen, Whether it was moſt deſirable to be learned or rich? he anſwered, that it was far better to be rich; for the learned were always dependent on the rich, and waiting at their doors; whereas, he never ſaw rich men at the doors of the learned. When he was accuſed of being ſo ſordid as to ſell part of the proviſions with which his table was furniſhed by Hiero, he ſaid he had done it in order "to diſplay to the world the magnificence of that prince and his own frugality." To others he ſaid, that his reaſon for accumulating wealth was, that "he would rather leave money to his enemies after death, than be troubleſome to his friends while living."

He obtained the prize in poetry at the public games when he was fourſcore years of age. According to Suidas, he added four letters to the Greek alphabet; and Pliny aſſigns to him the eighth ſtring of the lyre; but theſe claims are diſputed by the learned.

His poetry was ſo tender and plaintive, that he acquired the cognomen of *Melicertes* "ſweet as honey;" and the tearful eye of his muſe was proverbial. Dionyſius places him among thoſe poliſhed writers who excel in a ſmooth volubility, and flow on like plenteous and perennial rivers, in a courſe of even and uninterrupted harmony.

It is to Dionyſius that we are indebted for the preſervation of the following fragment of this poet. Danae being by her mercileſs father incloſed in a cheſt, and thrown into the ſea with her child, when night comes on, and a ſtorm ariſes which threatens to overſet the cheſt, ſhe, weeping and embracing the young Perſeus, cries out:

Sweet child! what anguiſh does thy mother know,
Ere cruel grief has taught thy tears to flow!
Amidſt the roaring wind's tremendous ſound,
Which threats deſtruction as it howls around;
In balmy ſleep thou lieſt, as at the breaſt,
Without one bitter thought to break thy reſt.——
The glimm'ring moon in pity hides her light,
And ſhrinks with horror at the ghaſtly ſight.
Didſt thou but know, ſweet innocent! our woes,
Not opiate's pow'r thy eyelids now could cloſe.
Sleep on, ſweet babe! ye waves in ſilence roll;
And lull, O lull, to reſt my tortur'd ſoul!

There is a ſecond great poet of the name of Simonides recorded on the Marbles, ſuppoſed to have been his grandſon, and who gained, in 478 B. C. the prize in the games at Athens.

SIMONY, is the corrupt preſentation of any one to an eccleſiaſtical benefice for money, gift, or reward. It is ſo called from the reſemblance it is ſaid to bear to the ſin of Simon Magus, though the purchaſing of holy orders ſeems to approach nearer to his offence. It was by the canon law a very grievous crime: and is ſo much the more odious, becauſe, as Sir Edward Coke obſerves, it is ever accompanied with perjury; for the preſentee is ſworn to have committed no ſimony. However, it was not an offence puniſhable in a criminal way at the common law: it being thought ſufficient to leave the clerk to eccleſiaſtical cenſures. But as theſe did not affect the ſimoniacal patron, nor were efficacious enough to repel the notorious practice of the thing, divers acts of parliament have been made to reſtrain it by means of civil forfeitures; which the modern prevailing uſage, with regard to ſpiritual preferments, calls aloud to be put in execution. The ſtatute 31 Eliz. c. 6. enacts, that if any patron, for money or any other corrupt conſideration or promiſe, directly or indirectly given, ſhall preſent, admit, inſtitute, induct, inſtall, or collate any perſon to an eccleſiaſtical benefice or dignity, both the giver and taker ſhall forfeit two years value of the benefice or dignity; one moiety to the king, and the other to any one who will ſue for the ſame. If perſons alſo corruptly reſign or exchange their benefices, both the giver and taker ſhall in like manner forfeit double the value of the money or other corrupt conſideration. And perſons who ſhall corruptly ordain or licenſe any miniſter, or procure him to be ordained or licenſed (which is the true idea of ſimony), ſhall incur a like forfeiture of forty pounds; and the miniſter himſelf of ten pounds, beſides an incapacity to hold any eccleſiaſtical preferment for ſeven years afterwards. Corrupt elections and reſignations in colleges, hoſpitals, and other eleemoſynary corporations, are alſo puniſhed, by the ſame ſtatute, with forfeiture of the double value, vacating the place or office, and a devolution of the right of election, for that turn, to the crown.

Simony, Simoom.

SIMOOM, a hot wind which blows occaſionally in the deſerts of Africa, and probably in other widely extended countries parched in the ſame manner by a vertical ſun. Its effects on the human body are dreadful. If inhaled in any quantity, it produces inſtant ſuffocation, or at leaſt leaves the unhappy ſufferer oppreſſed with aſthma and lowneſs of ſpirits. The approach of this awful ſcourge of God is indicated by a redneſs in the air, well underſtood by thoſe who are accuſtomed to journey through the deſert; and the only refuge which they have from it, is to fall down with their faces cloſe to the ground, and to continue as long as poſſible without drawing in their breath.

Mr Bruce, who, in his journey through the deſert, ſuffered from the ſimoom, gives of it the following graphical deſcription: "At eleven o'clock, while we contemplated with great pleaſure the rugged top of Chigre, to which we were faſt approaching, and where we were to ſolace ourſelves with plenty of good water, Idris our guide cried out, with a loud voice, fall upon you faces, for here is the ſimoom. I ſaw from the ſouth-eaſt a haze come, in colour like the purple part of the rainbow, but not ſo compreſſed or thick. It did not occupy twenty yards in breadth, and was about twelve feet high from the ground. It was a kind of bluſh upon the air, and it moved very rapidly; for I ſcarce could turn to fall upon the ground with my head to the northward, when I felt the heat of its current plainly upon my face. We all lay flat on the ground as if dead, till Idris told us it was blown over. The meteor or purple haze which I ſaw was indeed paſſed, but the light air that ſtill blew was of heat to threaten

Bruce's Travels, vol. iv. p. 559.

Simple, Simplicity.

threaten ſuffocation. For my part, I found diſtinctly in my breaſt that I had imbibed a part of it, nor was I free of an aſthmatic ſenſation till I had been ſome months in Italy, at the baths of Poretta, near two years afterwards." Though the ſeverity of this blaſt ſeems to have paſſed over them almoſt inſtantaneouſly, it continued to blow ſo as to exhauſt them till twenty minutes before five in the afternoon, laſting through all its ſtages very near ſix hours, and leaving them in a ſtate of the utmoſt deſpondency.

SIMPLE, ſomething not mixed or compounded; in which ſenſe it ſtands oppoſed to *compound*.

SIMPLE, in the materia medica, a general name for all herbs or plants, as having each its particular virtue, whereby it becomes a ſimple remedy.

SIMPLICITY IN WRITING. If we examine the writers whoſe compoſitions have ſtood the teſt of ages, and obtained that higheſt honour, "the concurrent approbation of diſtant times and nations," we ſhall find that the character of ſimplicity is the unvarying circumſtance which alone hath been able to gain this univerſal homage from mankind. Among the Greeks, whoſe writers in general are of the ſimple kind, the divineſt poet, the moſt commanding orator, the fineſt hiſtorian, and deepeſt philoſopher, are, above the reſt, conſpicuouſly eminent in this great quality. The Roman writers riſe towards perfection according to that meaſure of ſimplicity which they mingle in their works; indeed they are all inferior to the Greek models. But who will deny that Lucretius, Horace, Virgil, Livy, Terence, Tully, are at once the ſimpleſt and beſt of Roman writers? unleſs we add the noble annaliſt who appeared in after-times; who, notwithſtanding the political turn of his genius, which ſometimes interferes, is admirable in this great quality, and by it far ſuperior to his contemporaries. It is this one circumſtance that hath raiſed the venerable Dante, the father of modern poetry, above the ſucceeding poets of his country, who could never long maintain the local and temporary honours beſtowed upon them; but have fallen under that juſt neglect which time will ever decree to thoſe who deſert a juſt ſimplicity for the florid colourings of ſtyle, contraſted phraſes, affected conceits, the mere trappings of compoſition and Gothic minutiæ. It is this hath given to Boileau the moſt laſting wreath in France, and to Shakeſpeare and Milton in England; eſpecially to the former, whoſe writings contain ſpecimens of perhaps the pureſt and ſimpleſt Engliſh that is anywhere to be found, except in the Bible or Book of Common Prayer. As it appears from theſe inſtances, that ſimplicity is the only univerſal characteriſtic of juſt writing, ſo the ſuperior eminence of the ſacred Scriptures in this quality hath been generally acknowledged. One of the greateſt critics in antiquity, himſelf conſpicuous in the ſublime and ſimple manner, hath borne this teſtimony to the writings of Moſes and St Paul; and by parity of reaſon we muſt conclude, that had he been converſant with the other ſacred writers, his taſte and candour would have allowed them the ſame encomium.

It hath been often obſerved even by writers of no mean rank, that the "Scriptures ſuffer in their credit by the diſadvantage of a literal verſion, while other ancient writings enjoy the advantage of a free and embelliſhed tranſlation." But in reality theſe gentlemens concern is ill-placed and groundleſs: for the truth is, "that moſt other writings are impaired by a literal tranſlation; whereas giving only a due regard to the idiom of different languages, the ſacred writings, when literally tranſlated, are then in their full perfection."

Simplicity ‖ Simpſon.

Now this is an internal proof, that in all other writings there is a mixture of local, relative, exterior ornament, which is often loſt in the tranſfuſion from one language to another. But the internal beauties, which depend not on the particular conſtruction of tongues, no change of tongue can deſtroy. Hence the Bible preſerves its native beauty and ſtrength alike in every language, by the ſole energy of unadorned phraſe, natural images, weight of ſentiment, and great ſimplicity.

It is in this reſpect like a rich vein of gold, which, under the ſevereſt trials of heat, cold, and moiſture, retains its original weight and ſplendour, without either loſs or alloy; while baſer metals are corrupted by earth, air, water, fire, and aſſimilated to the various elements through which they paſs.

This circumſtance, then, may be juſtly regarded as ſufficient to vindicate the compoſition of the ſacred Scriptures, as it is at once their chief excellence and greateſt ſecurity. It is their excellence, as it renders them intelligible and uſeful to all; it is their ſecurity, as it prevents their being diſguiſed by the falſe and capricious ornaments of vain or weak tranſlators. We may ſafely appeal to experience and fact for the confirmation of theſe remarks on the ſuperior ſimplicity, utility, and excellence, of the ſtyle of the Holy Scripture. Is there any book in the world ſo perfectly adapted to all capacities? that contains ſuch ſublime and exalted precepts, conveyed in ſuch an artleſs and intelligible ſtrain, that can be read with ſuch pleaſure and advantage by the lettered ſage and the unlettered peaſant?

SIMPLOCE. See ORATORY, n° 72.

SIMPSON (Thomas), profeſſor of mathematics at the royal academy at Woolwich, fellow of the Royal Society, and member of the Royal Academy at Stockholm, was born at Market Boſworth in Leiceſterſhire in 1710. His father, a ſtuff-weaver, taught him only to read Engliſh, and brought him up to his own buſineſs; but meeting with a ſcientifical pedlar, who likewiſe practiſed fortune-telling, young Simpſon by his aſſiſtance and advice left off weaving, and profeſſed aſtrology. As he improved in knowledge, however, he grew diſguſted with his pretended art; and renouncing it, was driven to ſuch difficulties for the ſubſiſtence of his family, that he came up to London, where he worked as a weaver, and taught mathematics at his ſpare hours. As his ſcholars increaſed, his abilities became better known, and he publiſhed his Treatiſe on Fluxions, by ſubſcription, in 1737: in 1740, he publiſhed his Treatiſe on the Nature and Laws of Chance; and Eſſays in Speculative and Mixed Mathematics. After theſe appeared his Doctrine of Annuities and Reverſions; Mathematical Diſſertations; Treatiſe on Algebra; Elements of Geometry; Trigonometry, Plane and Spherical; Select Exerciſes; and his Doctrine and Application of Fluxions, which he profeſſes to be rather a new work, than a ſecond edition of his former publication on fluxions. In 1743, he obtained the mathematical profeſſorſhip at Woolwich academy; and ſoon after was choſen a member of the Royal Society, when the preſident and council, in conſideration of his moderate circumſtances, were pleaſed to excuſe his admiſſion-

Simpſon, Simſon.

fees, and his giving bonds for the ſettled future payments. At the academy he exerted all his abilities in inſtructing the pupils who were the immediate objects of his duty, as well as others whom the ſuperior officers of the ordnance permitted to be boarded and lodged in his houſe. In his manner of teaching he had a peculiar and happy addreſs, a certain dignity and perſpicuity, tempered with ſuch a degree of mildneſs, as engaged the attention, eſteem, and friendſhip, of his ſcholars. He therefore acquired great applauſe from his ſuperiors in the diſcharge of his duty. His application and cloſe confinement, however, injured his health. Exerciſe and a proper regimen were preſcribed to him, but to little purpoſe: for his ſpirits ſunk gradually, till he became incapable of performing his duty, or even of reading the letters of his friends. The effects of this decay of nature were greatly increaſed by vexation of mind, owing to the haughty and inſulting behaviour of his ſuperior the firſt profeſſor of mathematics. This perſon, greatly his inferior in mathematical accompliſhments, did what he could to make his ſituation uneaſy, and even to depreciate him in the public opinion: but it was a vain endeavour, and only ſerved to depreſs himſelf. At length his phyſicians adviſed his native air for his recovery, and he ſet out in February 1761; but was ſo fatigued by his journey, that upon his arrival at Boſworth, he betook himſelf to his chamber, and grew continually worſe till the day of his death, which happened on the 14th of May, in the 51ſt year of his age.

SIMSON (Dr Robert), profeſſor of mathematics in the univerſity of Glaſgow, was born in the year 1687 of a reſpectable family, which had held a ſmall eſtate in the county of Lanerk for ſome generations. He was, we think, the ſecond ſon of the family. A younger brother was profeſſor of medicine in the univerſity of St Andrew's, and is known by ſome works of reputation, particularly a Diſſertation on the Nervous Syſtem, occaſioned by the Diſſection of a Brain completely Oſſified.

Dr Simſon was educated in the univerſity of Glaſgow under the eye of ſome of his relations who were profeſſors. Eager after knowledge, he made great progreſs in all his ſtudies; and, as his mind did not, at the very firſt openings of ſcience, ſtrike into that path which afterwards ſo ſtrongly attracted him, and in which he proceeded ſo far almoſt without a companion, he acquired in every walk of ſcience a ſtock of information, which, though it had never been much augmented afterwards, would have done credit to a profeſſional man in any of his ſtudies. He became, at a very early period, an adept in the philoſophy and theology of the ſchools, was able to ſupply the place of a ſick relation in the claſs of oriental languages, was noted for hiſtorical knowledge, and one of the moſt knowing botaniſts of his time.

It was during his theological ſtudies, as preparatory for his entering into orders, that mathematics took hold of his fancy. He uſed to tell in his convivial moments how he amuſed himſelf when preparing his exerciſes for the divinity hall. When tired with vague ſpeculation, in which he did not meet with certainty to reward his labours, he turned up a book of oriental philology, in which he found ſomething which he could diſcover to be true or to be falſe, without going out of the line of ſtudy which was to be of ultimate uſe to him. Sometimes even this could not relieve his fatigue. He then had recourſe to mathematics, which never failed to ſatisfy and refreſh him. For a long while he reſtricted himſelf to a very moderate uſe of the cordial, fearing that he would ſoon exhauſt the ſmall ſtock which ſo limited and abſtract a ſcience could yield; till at laſt he found, that the more he learned, a wider field opened to his view, and ſcenes that were inexhauſtible. Becoming acquainted with ſubjects far beyond the elements of the ſcience, and with numbers of names celebrated during that period of ardent reſearch all over Europe, he found it to be a manly and important ſtudy, by which he was as likely to acquire reputation as by any other. About this time, too, a proſpect began to open of making mathematics his profeſſion for life. He then gave himſelf up to it without reſerve.

Simſon.

His original incitement to this ſtudy as a treat, as ſomething to pleaſe and refreſh his mind in the midſt of ſeverer taſks, gave a particular turn to his mathematical ſtudies, from which he never could afterwards deviate. Perſpicuity and elegance are more attainable, and more diſcernible, in pure geometry, than in any other parts of the ſcience of meaſure. To this therefore he chiefly devoted himſelf. For the ſame reaſon he preferred the ancient method of ſtudying pure geometry, and even felt a diſlike to the Carteſian method of ſubſtituting ſymbols for operations of the mind, and ſtill more was he diſguſted with the ſubſtitution of ſymbols for the very objects of diſcuſſion, for lines, ſurfaces, ſolids, and their affections. He was rather diſpoſed in the ſolution of an algebraic problem, where quantity alone was conſidered, to ſubſtitute figure and its affections for the algebraic ſymbols, and to convert the algebraic formula into an analogous geometrical theorem. And he came at laſt to conſider algebraic analyſis as little better than a kind of mechanical knack, in which we proceed without ideas of any kind, and obtain a reſult without meaning, and without being conſcious of any proceſs of reaſoning, and therefore without any conviction of its truth. And there is no denying, that if genuine unſophiſticated taſte alone is to be conſulted, Dr Simſon was in the right: for though it muſt alſo be acknowledged, that the reaſoning in algebra is as ſtrict as in the pureſt geometry of Euclid or Apollonius, the *expert* analyſt has little perception of it as he goes on, and his final equation is not felt by himſelf as the reſult of ratiocination, any more than if he had obtained it by Paſcal's arithmetical mill. This does not in the leaſt diminiſh our admiration of the algebraic analyſis; for its almoſt boundleſs graſp, its rapid and certain procedure, and the delicate metaphyſics and great addreſs which may be diſplayed in conducting it. Such, however, was the ground of the ſtrong bias of Dr Simſon's mind to the analyſis of the ancient geometers. It increaſed as he went forward; and his veneration (we may call it his *love* or *affection*) for the ancient geometry was carried to a degree of idolatry. His chief labours were exerted in efforts to reſtore the works of the ancient geometers; and he has nowhere beſtowed much pains in advancing the modern diſcoveries in mathematics. The noble inventions, for example, of fluxions and of logarithms, by which our progreſs in mathematical knowledge, and in the uſeful application of this knowledge, is ſo much promoted, attracted the notice of Dr Simſon; but he has contented himſelf with demon-

1. *Satyrus, Ourang Outang.* 2. *Pongo* or *Jocko.* 3. *Simia Lar* or *Great Gibbon.*
4. *Simia Lar Minor* or *Little Gibbon.* 5. *Silvanus* or *Pygmy.* 6 & 7. *Inuus* or *Magot.*

A. B. del. Prin. Wal. Sculptor fecit.

8, *Nemestrina* or *Pig-tailed Baboon*. 9, *Sphinx* or *Great Baboon*. 10, *Apedia* or *Little Baboon*. 11, *Mormon* or *Mantegar*. 12, *The Male Maimon* or *Mandril*. 13, *The Female Mandril*. 14, *Silvaticus* or *Wood Baboon*.

A. Bell Prin. Wal. Sculptor fecit.

20.

16.

22.

21.

19.

17.

18.

15.

13. Hamadryas or Dog-faced Monkey. 16. Silenus Albibarbatus or Lion-tailed Monkey. 17. Cynomologus or Hare-lipped Monkey. 18. Cynocephalus or Dog-headed Monkey. 19. Sabæus or Green Monkey. 20. Æthiops or Mangabey. 21. Aygula or Egret. 22. Corcopithecus regalis or King Monkey.

A. Bell Prin. Wat. Sculptor fecit.

SIMIÆ, Sapajous.

Plate CCCCLXX.

23.

25.

24.

SIMIÆ, Sagoins.

29.

27.

28.

26.

Sapajous 23, *Beelzebub* or *Preacher Monkey*. 24, *Capucinus Sai* or *Weeper*. 25, *Fatuellas* or *Horned Sapajou*.
Sagoins 26, *Jacchus* or *Striated Monkey*. 27, *Oedipus* or *Red tailed Monkey*. 28, *Rosalius* or *Silky Monkey*. 29, *Midas* or *Great eared Monkey*.

A. Bell Prin. Wal. Sculptor fecit.

Simſon. monſtrating their truth on the genuine principles of the ancient geometry. Yet was he very thoroughly acquainted with all the modern diſcoveries; and there are to be ſeen among his papers diſcuſſions and inveſtigations in the Carteſian method, which ſhow him thoroughly acquainted with all the principles, and even expert in the *tours de main*, of the moſt refined ſymbolical analyſis (A).

About the age of 25 Dr Simſon was choſen regius profeſſor of mathematics in the univerſity of Glaſgow. He went to London immediately after his appointment, and there formed an acquaintance with the moſt eminent men of that bright era of Britiſh ſcience. Among theſe he always mentioned Captain Halley (the celebrated Dr Edmund Halley) with particular reſpect; ſaying, that he had the moſt acute penetration, and the moſt juſt taſte in that ſcience, of any man he had ever known. And, indeed, Dr Halley has ſtrongly examplified both of theſe in his divination of the work of *Apollonius de Sectione Spatii*, and the 8th book of his *Conics*, and in ſome of the moſt beautiful theorems in Sir Iſaac Newton's *Principia*. Dr Simſon alſo admired the wide and maſterly ſteps which Newton was accuſtomed to take in his inveſtigations, and his manner of ſubſtituting geometrical figures for the quantities which are obſerved in the phenomena of nature. It was from Dr Simſon that the Writer of this article had the remarks which has been oftener than once repeated in the courſe of this Work, "That the 39th propoſition of the firſt book of the *Principia* was the moſt important propoſition that had ever been exhibited to the phyſico-mathematical philoſopher;" and he uſed always to illuſtrate to his more advanced ſcholars the ſuperiority of the geometrical over the algebraic analyſis, by comparing the ſolution given by Newton of the inverſe problem of centripetal forces, in the 42d propoſition of that book, with the one given by John Bernoulli in the *Memoirs* of the Academy of Sciences at Paris for 1713. We have heard him ſay, that to his own knowledge Newton frequently inveſtigated his propoſitions in the ſymbolical way, and that it was owing chiefly to Dr Halley that they did not finally appear in that dreſs. But if Dr Simſon was well informed, we think it a great argument in favour of the ſymbolic analyſis, when this moſt ſucceſsful *practical artiſt* (for ſo we muſt call Newton when engaged in a taſk of diſcovery) found it conducive either to diſpatch or perhaps to his very progreſs.

Returning to his academical chair, Dr Simſon diſcharged the duties of a profeſſor for more than 50 years with great honour to the univerſity and to himſelf.

It is almoſt needleſs to ſay, that in his prelections he followed ſtrictly the Euclidian method in elementary geometry. He made uſe of Theodoſius as an introduction to ſpherical trigonometry In the higher geometry he prelected from his own Conics; and he gave a ſmall ſpecimen of the *linear problems* of the ancients, by explaining the properties, ſometimes of the conchoid, ſometimes of the ciſſoid, with their application to the ſolution of ſuch problems. In the more advanced claſs he was accuſtomed to give Napier's mode of conceiving logarithms, *i. e.* quantities as generated by motion; and Mr Cotes's view of them, as the ſums of ratiunculæ; and to demonſtrate Newton's lemmas concerning the limits of ratios; and then to give the elements of the fluxionary calculus; and to finiſh his courſe with a ſelect ſet of propoſitions in optics, gnomonics, and central forces. His method of teaching was ſimple and perſpicuous, his elocution clear, and his manner eaſy and impreſſive. He had the reſpect, and ſtill more the affection, of his ſcholars. Simſon.

With reſpect to his ſtudies, we have already informed the reader that they got an early bias to pure geometry, and to the elegant but ſcrupulous methods of the ancients.

We have heard Dr Simſon ſay, that it was in a great meaſure owing to Dr Halley that he ſo early directed his efforts to the reſtoration of the ancient geometers. He had recommended this to him, as the moſt certain way for him, then a very young man, both to acquire reputation, and to improve his own knowledge and taſte, and he preſented him with a copy of Pappus's Mathematical Collections, enriched with ſome of his own notes. The perſpicuity of the ancient geometrical analyſis, and a certain elegance in the nature of the ſolutions which it affords, eſpecially by means of the local theorems, ſoon took firm hold of his fancy, and made him, with the ſanguine expectation of a young man, direct his very firſt efforts to the recovery of this *in toto*; and the reſtoration of Euclid's Poriſms was the firſt taſk which he ſet himſelf. The accompliſhed geometer knows what a deſperate taſk this was, from the ſcanty and mutilated account which we have of this work in a ſingle paſſage of Pappus. It was an ambition which nothing but ſucceſs could juſtify in ſo young an adventurer. He ſucceeded; and ſo early as 1718 ſeemed to have been in complete poſſeſſion of this method of inveſtigation, which was conſidered by the eminent geometers of antiquity as their ſureſt guide through the labyrinths of the higher geometry. Dr Simſon gave a ſpecimen of his diſcovery in 1723 in the Philoſophical Tranſactions. And after this time he ceaſed not from his endeavours to recover that choice collection of Poriſms which Euclid had collected, as of the moſt general uſe in the ſolution of difficult queſtions. What ſome of theſe muſt have been was pointed out to Dr Simſon by the very nature of the general propoſition of Pappus, which he has reſtored. Others were pointed out by the lemmas which Pappus has given as helps to the young mathematician towards their demonſtration. And, being thus in poſſeſſion of a conſiderable number, their mutual relations pointed out a ſort of ſyſtem, of which theſe made a part, and of which the blanks now remained to be filled up. Simſon.

Dr Simſon, having thus gained his favourite point, had

(A) In 1752 the writer of this article being then his ſcholar, requeſted him to examine an account which he gave him of what he thought a new curve (a conchoid having a circle for its baſe). Dr Simſon returned it next day with a regular liſt of its leading properties, and the inveſtigation of ſuch as he thought his ſcholar would not ſo eaſily trace. In this haſty ſcrawl the lines related to the circle were familiarly conſidered as arithmetical fractions of the radius conſidered as unity. This was before Euler publiſhed his Arithmetic of the Sines and Tangents, now in univerſal uſe.

Simſon. had leiſure to turn his attention to the other works of the ancient geometers, and the poriſms of Euclid now had only an occaſional ſhare. The *loci plani* of Apollonius was another taſk which he very early engaged in, and completed about the year 1738. But, after it was printed, he imagined that he had not given the *ipſiſſimæ propoſitiones* of Apollonius, and in the preciſe ſpirit and order of that author. The impreſſion lay by him for ſome years; and it was with great reluctance that he yielded to the intreaties of his mathematical friends, and publiſhed the work, in 1746, with ſome emendations, where he thought he had deviated fartheſt from his author. He quickly repented of this ſcanty conceſſion, and recalled what he could of the ſmall number of copies which he had given to the bookſellers, and the impreſſion again lay by him for years. He afterwards re-corrected the work, and ſtill with ſome reluctance allowed it to come abroad as the Reſtitution of Apollonius. The public, however, had not been ſo faſtidious as Dr Simſon, and the work had acquired great celebrity, and he was now conſidered as one of the firſt and the moſt elegant geometers of the age: for, in the mean time, he had publiſhed his Conic Sections, a work of uncommon merit, whether we conſider it as equivalent to a complete reſtitution of the celebrated work of Apollonius Pergæus, or as an excellent ſyſtem of this important part of mathematics. It is marked with the ſame features as the *loci plani*, the moſt anxious ſolicitude to exhibit the very text of Apollonius, even in the propoſitions belonging to the books which had been completely loſt. Theſe could be recovered in no other way but by a thorough knowledge of the preciſe plan propoſed by the author, and by taking it for granted that the author had accurately accompliſhed this plan. In this manner did Viviani proceed in the firſt attempt which was made to reſtore the conics of Apollonius; and he has given us a detail of the proceſs of his conjectures, by which we may form an opinion of its juſtneſs, and of the probability how far he has attained the deſired object. Dr Simſon's view in his performance was ſomething different, deviating a little in this one caſe from his general track. He was not altogether pleaſed with the work of Viviani, even as augmented by the eighth book added by Halley, and his wiſh was to reſtore the ancient original. But, in the mean time, an academical text book for conic ſections was much wanted. He was much diſſatisfied with thoſe in common uſe; and he was not inſenſible of the advantage reſulting from the conſideration of theſe ſections, independent of the cone firſt introduced by Dr Wallis. He therefore compoſed this excellent treatiſe as an elementary book, not to ſuperſede, but to prepare for the ſtudy of Apollonius; and accordingly accommodates it to this purpoſe, and gives ſeveral important propoſitions in their proper places, *expreſsly as reſtitutions of Apollonius*, whom he keeps conſtantly in view through the whole work.

Much about this time Dr Simſon ſeriouſly began to prepare a perfect edition of Euclid's Elements. The intimate acquaintance which he had by this time acquired with all the original works of the ancient geometers, and their ancient commentators and critics, encouraged him to hope that he could reſtore to his original luſtre this leader in mathematical ſcie e; and the errors which had crept into this celebrated work, and which ſtill remained in it, appeared of magnitude ſufficient to merit the moſt careful efforts for their removal. The DATA alſo, which were in like manner the introduction to the whole art of geometrical inveſtigation, ſeemed to call more loudly for his amending hand. For it appears that the Saracens, who have preſerved to us the writings of the ancients, have contented themſelves with admiring theſe celebrated works, and have availed themſelves of the knowledge which they contain; but they have ſhown no inclination to add to the ſtock, or to promote the ſciences which they had received. They could not do any thing without the ſynthetical books of the geometers; but, not meaning to go beyond the diſcoveries which they had made, they neglected all the books which related to the analytic art alone, and the greateſt part of them (about 25 out of 30) have irrecoverably periſhed. The data of Euclid have fortunately been preſerved, but the book was neglected, and the only ancient copies, which are but three or four, are miſerably erroneous and mutilated. Fortunately, it is no very arduous matter to reinſtate this work in its original perfection. The plan is preciſe, both in its extent and its method. It had been reſtored, therefore, with ſucceſs by more than one author. But Dr Simſon's comprehenſive view of the whole analytical ſyſtem pointed out to him many occaſions for amendment. He therefore made its inſtitution a joint taſk with that of the elements. All the lovers of true geometry will acknowledge their obligations to him for the edition of the Elements and data which he publiſhed about 1758. The text is corrected with the moſt judicious and ſcrupulous care, and the notes are ineſtimable, both for their information, and for the tendency which they muſt have to form the mind of the ſtudent to a true judgment and taſte in mathematical ſubjects. The more accompliſhed reader will perhaps be ſometimes diſpoſed to ſmile at the axiom which ſeems to pervade the notes, "that a work of Euclid muſt be ſuppoſed without error or defect." If this was not the caſe, Euclid has been obliged to his editor in more inſtances than one. Nor ſhould his greateſt admirers think it impoſſible that in the progreſs of human improvement, a geometrical truth ſhould occur to one of theſe latter days, which eſcaped the notice of even the Lincean Euclid. Such merit, however, Dr Simſon nowhere claims, but lays every blame of error, omiſſion, or obſcurity, to the charge of Proclus, Theon, and other editors and commentators of the renowned Grecian.

Simſon.

There is another work of Apollonius on which Dr Simſon has beſtowed great pains, and has reſtored, as we imagine, *omnibus numeris perfectum*, viz. the SECTIO DETERMINATA; one of thoſe performances which are of indiſpenſable uſe in the application of the ancient analyſis. This alſo ſeems to have been an early taſk, tho' we do not know the date of his labours on it. It did not appear till after his death, being then publiſhed along with the great work, the Poriſms of Euclid, at the expence of the late Earl Stanhope, a nobleman intimately converſant with the ancient geometry, and zealous for its reception among the mathematicians of the preſent age. He had kept up a conſtant correſpondence with Dr Simſon on mathematical ſubjects; and at his death in 1768, engaged Mr Clow profeſſor of logic in the univerſity of Glaſgow, to whoſe care the Doctor had left all his valuable papers, to make a

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Simſon. ſelection of ſuch as would ſerve to ſupport and increaſe his well earned reputation as THE RESTORER of ANCIENT GEOMETRY.

We have been thus particular in our account of Dr Simſon's labours in theſe works, becauſe his manner of execution, while it does honour to his inventive powers, and ſhows his juſt taſte in mathematical compoſition, alſo confirms our former aſſertion, that he carried his reſpect for the ancient geometers to a degree of ſuperſtitious idolatry, and that his fancy, unchecked, viewed them as incapable of error or imperfection. This is diſtinctly to be ſeen in the emendations which he has given of the texts, particularly in his editions of Euclid. Not only every imperfection of the reading is aſcribed to the ignorance of copyiſts, and every indiſtinctneſs in the conception, inconcluſiveneſs in the reaſoning, and defect in the method, is aſcribed to the ignorance or miſtake of the commentators; but it is all along aſſumed that the work was perfect in its kind; and that by exhibiting a perfect work, we reſtore the genuine original. This is ſurely gratuitous; and it is very poſſible that it has, in ſome inſtances, made Dr Simſon fail of his anxious purpoſe, and give us even a better than the original. It has undoubtedly made him fail in what *ſhould have been* his great purpoſe, viz. to give the world a connected ſyſtem of the ancient geometrical analyſis; ſuch as would, in the firſt place, exhibit it in its moſt engaging form, elegant, perſpicuous, and comprehenſive; and, in the next place, ſuch as ſhould engage the mathematicians of the preſent age to adopt it as the moſt certain and ſucceſsful conductor in thoſe laborious and difficult reſearches in which the demands of modern ſcience continually engage them. And this might have been expected, in the province of ſpeculative geometry at leaſt, from a perſon of ſuch extenſive knowledge of the properties of figure, and who had ſo eminently ſucceeded in the many trials which he had made of its powers. We might have expected that he would at leaſt have exhibited in one ſyſtematic point of view, what the ancients had done in ſeveral detached branches of the ſcience, and how far they had proceeded in the ſolution of the ſeveral ſucceſſive claſſes of problems; and we might have hoped, that he would have inſtructed us in what manner we ſhould apply that method to the ſolution of problems of a more elevated kind, daily preſented to us in the queſtions of phyſico-mathematical ſcience. By this he would have acquired diſtinguiſhed honour, and ſcience would have received the moſt valuable improvement. But Dr Simſon has done little of all this; and we cannot ſay that great helps have been derived from his labours by the eminent mathematicians of this age, who are ſucceſsfully occupied in advancing our knowledge of nature, or in improving the arts of life. He has indeed contributed greatly to the entertainment of the ſpeculative mathematician, who is more delighted with the conſcious exerciſe of his own reaſoning powers, than with the final reſult of his reſearches. Yet we are not even certain that Dr Simſon has done this to the extent he wiſhed and hoped. He has not engaged the liking of mathematicians to this analyſis, by preſenting it in the moſt agreeable form. His own extreme anxiety to tread in the very footſteps of the original authors, has, in a thouſand inſtances, precluded him from uſing his own extenſive knowledge, that he might not employ principles which were not of a claſs inferior to that of the queſtion in hand. Thus, of neceſſity, did the method appear trammelled. We are deterred from employing a proceſs which appears to reſtrain us in the application of the knowledge which we have already acquired; and, diſguſted with the tedious, and perhaps indirect path, by which we muſt arrive at an object which we ſee clearly over the hedge, and which we could reach by a few ſteps, of the ſecurity of which we are otherwiſe perfectly aſſured. Theſe prepoſſeſſions are indeed founded on miſtake; but the miſtake is ſuch, that all fall into it, till experience has enlarged their views. This circumſtance alone has hitherto prevented mathematicians from acquiring that knowledge of the ancient analyſis which would enable them to proceed in their reſearches with certainty, diſpatch, and delight. It is therefore deeply to be regretted, that this eminent genius has occupied, in this ſuperſtitious palæology, a long and buſy life, which might have been employed in original works of infinite advantage to the world, and honour to himſelf. Simſon.

Our readers will, it is hoped, conſider theſe obſervations as of general ſcientific importance, and as intimately connected with the hiſtory of mathematics; and therefore as not improperly introduced in the biographical account of one of the moſt eminent writers on this ſcience. Dr Simſon claimed our notice as a mathematician; and his affectionate admiration of the ancient analyſis is the prominent feature of his literary character. By this he is known all over Europe; and his name is never mentioned by any foreign author without ſome very honourable alluſion to his diſtinguiſhed geometrical elegance and ſkill. Dr James Moor, profeſſor of Greek in the univerſity of Glaſgow, no leſs eminent for his knowledge in ancient geometry than for his profeſſional talents, put the following appoſite inſcription below a portrait of Dr Simſon:

GEOMETRIAM, SUB TYRANNO BARBARO SÆVA
SERVITUTE DIU SQUALENTEM, in LIBERTATEM
ET DECUS ANTIQUUM VINDICAVIT
UNUS.

Yet it muſt not be underſtood that Dr Simſon's predilection for the geometrical analyſis of the ancients did ſo far miſlead him as to make him neglect the ſymbolical analyſis of the preſent times; on the contrary, he was completely maſter of it, as has been already obſerved, and frequently employed it. In his academical lectures to the ſtudents of his upper claſſes, he uſed to point out its proper province (which he by no means limited by a ſcanty boundary), and in what caſes it might be applied with ſafety and advantage even to queſtions of pure geometry. He once honoured the writer of this article with the ſight of a very ſhort diſſertation on this ſubject (perhaps the one referred to in the preface to his Conic Sections). In this piece he was perhaps more liberal than the moſt zealous partiſans of the ſymbolical analyſis could deſire, admitting as a ſufficient equation of the Conic Sections $L = \frac{p^2 c}{x^2}$, where L is the *latus rectum*, x is the diſtance of any point of the curve from the focus, p is the perpendicular drawn from the focus to the tangent in the given point, and c is the chord of the equicurve circle drawn thro' the focus. Unfortunately this diſſertation was not found among his pa-

Simſon. pers. He ſpoke in high terms of the Analytical Works of Mr Cotes, and of the two Bernoullis. He was conſulted by Mr M'Laurin during the progreſs of his ineſtimable Treatiſe of Fluxions, and contributed not a little to the reputation of that work. The ſpirit of that moſt ingenious algebraic demonſtration of the fluxions of a rectangle, and the very proceſs of the argument, is the ſame with Dr Simſon's in his diſſertation on the limits of quantities. It was therefore from a thorough acquaintance with the ſubject, and by a juſt taſte, that he was induced to prefer his favourite analyſis, or, to ſpeak more properly, to exhort mathematicians to employ it in its own ſphere, and not to become ignorant of geometry, while they ſucceſsfully employed the ſymbolical analyſis in caſes which did not require it, and which ſuffered by its admiſſion. It muſt be acknowledged, however, that in his later years, the diſguſt which he felt at the artificial and ſlovenly employment on ſubjects of pure geometry, ſometimes hindered him from even looking at the moſt refined and ingenious improvements of the algebraic analyſis which occur in the writings of Euler, D'Alembert, and other eminent maſters. But, when properly informed of them, he never failed to give them their due praiſe; and we remember him ſpeaking, in terms of great ſatisfaction, of an improvement of the infiniteſimal calculus, by D'Alembert and De la Grange, in their reſearches concerning the propagation of ſound, and the vibrations of muſical cords.

And that Dr Simſon not only was maſter of this calculus and the ſymbolical calculus in general, but held them in proper eſteem, appears from two valuable diſſertations to be found in his poſthumous works; the one on logarithms, and the other on the limits of ratios. The laſt, in particular, ſhows how completely he was ſatisfied with reſpect to the ſolid foundation of the method of fluxions; and it contains an elegant and ſtrict demonſtration of all the applications which have been made of the method by its illuſtrious author to the objects of pure geometry.

We hoped to have given a much more complete and inſtructive account of this eminent geometer and his works, by the aid of a perſon fully acquainted with both, and able to appreciate their value; but an accident has deprived us of this aſſiſtance, when it was too late to procure an equivalent: and we muſt requeſt our readers to accept of this very imperfect account, ſince we cannot do juſtice to Dr Simſon's merit, unleſs almoſt equally converſant in all the geometry of the ancient Greeks.

The life of a literary man rarely teems with anecdote; and a mathematician, devoted to his ſtudies, is perhaps more abſtracted than any other perſon from the ordinary occurrences of life, and even the ordinary topics of converſation. Dr Simſon was of this claſs; and, having never married, lived entirely a college life. Having no occaſion for the commodious houſe to which his place in the univerſity intitled him, he contented himſelf with chambers, good indeed, and ſpacious enough for his ſober accommodation, and for receiving his choice collection of mathematical writers, but without any decoration or commodious furniture. His official ſervant ſufficed for valet, footman, and chambermaid. As this retirement was entirely devoted to ſtudy, he entertained no company in his chambers, but in a neighbouring houſe, where his apartment was ſacred to him and his gueſts. Simſon.

Having in early life devoted himſelf to the reſtoration of the works of the ancient geometers, he ſtudied them with unremitting attention; and, retiring from the promiſcuous intercourſe of the world, he contented himſelf with a ſmall ſociety of intimate friends, with whom he could lay aſide every reſtraint of ceremony or reſerve, and indulge in all the innocent frivolities of life. Every Friday evening was ſpent in a party at whiſt, in which he excelled, and took delight in inſtructing others, till increaſing years made him leſs patient with the dulneſs of a ſcholar. The card-party was followed by an hour or two dedicated ſolely to playful converſation. In like manner, every Saturday he had a leſs ſelect party to dinner at a houſe about a mile from town. The Doctor's long life gave him occaſion to ſee the *dramatis perſonæ* of this little theatre ſeveral times completely changed, while he continued to give it a perſonal identity: ſo that, without any deſign or wiſh of his own, it became, as it were, his own houſe and his own family, and went by his name. In this ſtate did the preſent writer firſt ſee it, with Dr Simſon as its father and head, reſpected and beloved by every branch; for, as it was for relaxation, and not for the enjoyment of his acknowledged ſuperiority, that he continued this habit of his early youth; and as his notions "of a fine talk" did not conſiſt in the pleaſure of having "toſſed and gored a good many to-day," his companions were as much at their eaſe as he wiſhed to be himſelf; and it was no ſmall part of their entertainment (and of his too), to ſmile at thoſe innocent deviations from common forms, and thoſe miſtakes with reſpect to life and manners, which an almoſt total retirement from the world, and inceſſant occupation in an abſtract ſcience, cauſed this venerable preſident frequently to exhibit. Theſe are remembered with a more affecting regret, that they are now "with the days that are paſt," than the moſt pithy apophthegms, uſhered in with an emphatical, "Why, Sir!" or "No, Sir!" which precludes all reply. Dr Simſon never exerted his preſidial authority, unleſs it were to check ſome infringement of good breeding, or any thing that appeared unfriendly to religion or purity of manners; for theſe he had the higheſt reverence. We have twice heard him ſing (he had a fine voice and moſt accurate ear) ſome lines of a Latin hymn to the divine geometer, and each time the rapturous tear ſtood in his eye.

But we aſk the reader's pardon for this digreſſion; it is not however uſeleſs, ſince it paints the man as much as any recital of his ſtudies; and to his acquaintances we are certain that it will be an acceptable memorandum. To them it was often matter of regret, that a perſon of ſuch eminent talents, which would have made him ſhine equally in any line of life, ſhould have allowed himſelf to be ſo completely devoted to a ſtudy which abſtracted him from the ordinary purſuits of men, unfitted him for the active enjoyment of life, and kept him out of thoſe walks which they frequented, and where they would have rejoiced to meet him.

Dr Simſon was of an advantageous ſtature, with a fine countenance; and even in his old age had a graceful carriage and manner, and always, except when in mourning, dreſſed in white cloth. He was of a cheerful diſpoſition; and though he did not make the firſt advances

Sin, Sinai.

advances to acquaintance, had the moſt affable manner, and ſtrangers were at perfect eaſe in his company. He enjoyed a long courſe of uninterrupted health; but towards the cloſe of life ſuffered from an acute diſeaſe, and was obliged to employ an aſſiſtant in his profeſſional labours for a few years preceding his death, which happened in 1768, at the age of 81. He left to the univerſity his valuable library, which is now arranged apart from the reſt of the books, and the public uſe of it is limited by particular rules. It is conſidered as the moſt choice collection of mathematical books and manuſcripts in the kingdom, and many of them are rendered doubly valuable by Dr Simſon's notes.

SIN, a breach or tranſgreſſion of ſome divine law or command.

SINAI, or SINA, a famous mountain of Arabia Petræa, upon which God gave the law to Moſes. It ſtands in a kind of peninſula, formed by the two arms of the Red Sea, one of which ſtretches out towards the north, and is called the *Gulph of Kolſum*; the other extends towards the eaſt, and is called the *Gulph of Elan*, or the *Elaniſh Sea*. At this day the Arabians call Mount Sinai by the name of *Tor*, that is, the "mountain," by way of excellence; or *Gibel* or *Jibel Mouſa*, "the mountain of Moſes." It is 260 miles from Cairo, and generally it requires a journey of ten days to travel thither. The wilderneſs of Sinai, where the Iſraelites continued incamped for almoſt a year, and where Moſes erected the tabernacle of the covenant, is conſiderably elevated above the reſt of the country; and the aſcent to it is by a very craggy way, the greateſt part of which is cut out of the rock; then one comes to a large ſpace of ground, which is a plain ſurrounded on all ſides by rocks and eminences, whoſe length is nearly 12 miles. Towards the extremity of this plain, on the north ſide, two high mountains ſhow themſelves, the higheſt of which is called *Sinai* and the other *Horeb*. The tops of Horeb and Sinai have a very ſteep aſcent, and do not ſtand upon much ground, in compariſon to their extraordinary height: that of Sinai is at leaſt one-third part higher than the other, and its aſcent is more upright and difficult.

Niebuhr's Travels, vol. i. p. 192.

Two German miles and a half up the mountain ſtands the convent of St Catharine. The body of this monaſtery is a building 120 feet in length and almoſt as many in breadth. Before it ſtands another ſmall building, in which is the only gate of the convent, which remains always ſhut, except when the biſhop is here. At other times, whatever is introduced within the convent, whether men or proviſions, is drawn up by the roof in a baſket, and with a cord and a pulley. The whole building is of hewn ſtone; which, in ſuch a deſert, muſt have coſt prodigious expence and pains. Near this chapel iſſues a fountain of very good freſh water; it is looked upon as miraculous by ſome who cannot conceive how water can flow from the brow of ſo high and barren a mountain. Five or ſix paces from it they ſhow a ſtone, the height of which is four or five feet, and breadth about three, which, they ſay, is the very ſtone whence Moſes cauſed the water to guſh out. Its colour is of a ſpotted grey, and it is as it were ſet in a kind of earth, where no other rock appears. This ſtone has 12 holes or channels, which are about a foot wide, whence it is thought the water came forth for the Iſraelites to drink.

Much has been ſaid of the writings to be ſeen at Sinai and in the plain about it; and ſuch were the hopes of diſcoveries reſpecting the wanderings of the Iſraelites from theſe writings, that Dr Clayton biſhop of Clogher offered L. 500 Sterling to defray the expences of journey to any man of letters who would undertake to copy them. No man, we believe, undertook this taſk: and the accurate Daniſh traveller Niebuhr found no writings there but the names of perſons who had viſited the place from curioſity, and of Egyptians who had choſen to be buried in that region. Sinapis.

SINAPIS, MUSTARD, in botany: A genus of plants belonging to the claſs of *tetradynamia*, and to the order of *ſiliquoſa*; and in the natural ſyſtem ranged under the 39th order, *Siliquoſæ*. The calyx conſiſts of four expanding ſtrap-ſhaped deciduous leaves; the ungues or baſes of the petals are ſtraight; two glandules between the ſhorter ſtamina and piſtillum, alſo between the longer and the calyx. There are 17 ſpecies; the arvenſis, orientalis, braſſicata, alba, nigra, pyrenaica, pubeſcens, chinenſis, juncea, erucoides, allioni, hiſpanica, millefolia, incana, lævigata, cernua, and japonica. Three of theſe are natives of Britain; the alba, nigra, and arvenſis.

1. The alba, or white muſtard, which is generally cultivated as a ſalad herb for winter and ſpring uſe. This riſes with a branched hairy ſtalk two feet high; the leaves are deeply jagged on their edges and rough. The flowers are diſpoſed in looſe ſpikes at the end of the branches, ſtanding upon horizontal footſtalks; they have four yellow petals in form of a croſs, which are ſucceeded by hairy pods, that end with long, compreſſed, oblique beaks; the pods generally contain four white ſeeds.

2. The nigra, or common muſtard, which is frequently found growing naturally in many parts of Britain, but is alſo cultivated in fields for the ſeed, of which the ſauce called *muſtard* is made. This riſes with a branching ſtalk four or five feet high; the lower leaves are large, rough, and very like thoſe of turnip; the upper leaves are ſmaller and leſs jagged. The flowers are ſmall, yellow, and grow in ſpiked cluſters at the end of the branches; they have four petals placed in form of a croſs, and are ſucceeded by ſmooth four-cornered pods.

3. The arvenſis, grows naturally on arable land in many parts of Britain. The ſeed of this is commonly ſold under the title of *Durham muſtard-ſeed*. Of this there are two varieties, if not diſtinct ſpecies; the one with cut, the other with entire leaves. The ſtalks riſe two feet high; the leaves are rough; in the one they are jagged like turnip-leaves; in the other they are long and entire. The flowers are yellow; the pods are turgid, angular, and have long beaks.

Muſtard, by its acrimony and pungency, ſtimulates the ſolids, and attenuates viſcid juices; and hence ſtands deſervedly recommended for exciting appetite, aſſiſting digeſtion, promoting the fluid ſecretions, and for the other purpoſes of the acrid plants called *antiſcorbutic*. It imparts its taſte and ſmell in perfection to aqueous liquors, and by diſtillation with water yields an eſſential oil of great acrimony. To rectified ſpirit its ſeeds give out very little either of their ſmell or taſte. Subjected to the preſs, they yield a conſiderable quantity of a mild inſipid oil, which is as free from acrimony as that

of

Sinapiſm || Sindy.

of almonds. They are applied as an external ſtimulant to benumbed or paralytic limbs; to parts affected with fixed rheumatic pains; and to the ſoles of the feet, in the low ſtage of acute diſeaſes, for raiſing the pulſe: in this intention, a mixture of equal parts of the powdered ſeeds and crumb of bread, with the addition ſometimes of a little bruiſed garlic, are made into a cataplaſm with a ſufficient quantity of vinegar.

SINAPISM, in pharmacy, an external medicine, in form of a cataplaſm, compoſed chiefly of muſtard-ſeed pulverized, and other ingredients mentioned in the preceding article.

SINCERITY, honeſty of intention, freedom from hypocriſy. See MORAL PHILOSOPHY, n° 157.

SINCIPUT, in anatomy, the forepart of the head, reaching from the forehead to the coronal future.

SINDY, a province of Hindoſtan Proper, bounded on the weſt by Makran, a province of Perſia; on the north by the territories of the king of Candahar; on the north-eaſt by thoſe of the Seiks; on the eaſt by a ſandy deſert; and on the ſouth-eaſt by Cutch. It extends along the courſe of the river Sinde or Indus from its mouth to Behker or Bhakor, on the frontiers of Moultan. Reckoned that way, it is 300 miles long; and its breadth, in its wideſt part, is about 160. In many particulars of ſoil and climate, and in the general appearance of the ſurface, Sindy reſembles Egypt; the lower part of it being compoſed of rich vegetable mould, and extended into a wide dell; while the upper part of it is a narrow ſlip of country, confined on one ſide by a ridge of mountains, and on the other by a ſandy deſert, the river Indus, equal at leaſt to the Nile, winding through the midſt of this level valley, and annually overflowing it. During great part of the ſouth-weſt monſoon, or at leaſt in the months of July, Auguſt, and part of September, which is the rainy ſeaſon in moſt other parts of India, the atmoſphere is here generally clouded; but no rain falls except very near the ſea. Indeed, very few ſhowers fall during the whole year; owing to which, and the neighbourhood of the ſandy deſerts, which bound it on the eaſt and on the north-weſt, the heats are ſo violent, and the winds from thoſe quarters ſo pernicious, that the houſes are contrived ſo as to be occaſionally ventilated by means of apertures on the tops of them, reſembling the funnels of ſmall chimneys. When the hot winds prevail, the windows are cloſely ſhut; and the loweſt part of the current of air, which is always the hotteſt, being thus excluded, a cooler, becauſe more elevated, part deſcends into the houſe through the funnels. By this contrivance alſo vaſt clouds of duſt are excluded; the entrance of which would alone be ſufficient to render the houſes uninhabitable. The roofs are compoſed of thick layers of earth inſtead of terraces. Few countries are more unwholeſome to European conſtitutions, particularly the lower part of the Delta. The prince of this province is a Mahometan, tributary to the king of Candahar. He reſides at Hydrabad, although Tatta is the capital. The Hindoos, who were the original inhabitants of Sindy, are by their Mahometan governors treated with great rigour, and denied the public exerciſe of their religion; and this ſeverity drives vaſt numbers of them into other countries. The inland parts of Sindy produce ſaltpetre, ſal-ammoniac, borax, bezoar, lapis lazuli, and raw ſilk. They have alſo manufactories of cotton and ſilk of various kinds; and they make fine cabinets, inlaid with ivory, and finely lackered. They alſo export great quantities of butter, clarified and wrapt up in duppas, made of the hides of cattle. The ladies wear hoops of ivory on both their arms and legs, which when they die are burnt with them. They have large black cattle, excellent mutton, and ſmall hardy horſes. Their wild game are deer, hares, antelopes, and foxes, which they hunt with dogs, leopards, and a ſmall fierce creature called a ſhiahguſh.

Sine || Siniſter.

SINE, or *Right* SINE *of an Arch*, in trigonometry, is a right line drawn from one end of that arch, perpendicular to the radius drawn to the other end of the arch; being always equal to half the cord of twice the arch. See TRIGONOMETRY and GEOMETRY.

SINECURE, a nominal office, which has a revenue without any employment.

SINEW, a tendon, that which unites the muſcles to the bones.

SINGING, the action of making divers inflections of the voice, agreeable to the ear, and correſpondent to the notes of a ſong or piece of melody. See MELODY.

The firſt thing to be done in learning to ſing, is to raiſe a ſcale of notes by tones and ſemitones to an octave, and deſcend by the ſame notes; and then to riſe and fall by greater intervals, as a third, fourth, fifth, &c. and to do all this by notes of different pitch. Then theſe notes are repreſented by lines and ſpaces, to which the ſyllables *fa*, *ſol*, *la*, *mi*, are applied, and the pupil taught to name each line and ſpace thereby; whence this practice is called *ſol-faing*, the nature, reaſon, effects, &c. whereof, ſee under the article SOLFAING.

SINGING of Birds. It is worthy of obſervation, that the female of no ſpecies of birds ever ſings: with birds it is the reverſe of what occurs in human kind. Among the feathered tribe, all the cares of life fall to the lot of the tender ſex; theirs is the fatigue of incubation; and the principal ſhare in nurſing the helpleſs brood: to alleviate theſe fatigues, and to ſupport her under them, nature hath given to the male the ſong, with all the little blandiſhments and ſoothing arts; theſe he fondly exerts (even after courtſhip) on ſome ſpray contiguous to the neſt, during the time his mate is performing her parental duties. But that ſhe ſhould be ſilent is alſo another wiſe proviſion of nature, for her ſong would diſcover her neſt; as would a gaudineſs of plumage, which, for the ſame reaſon, ſeems to have been denied her.

On the ſong of birds ſeveral curious experiments and obſervations have been made by the Hon. Daines Barrington. See *Phil. Tranſ.* vol. lxiii.

SINGULAR NUMBER, in grammar, that number of nouns and verbs which ſtands oppoſed to plural. See GRAMMAR, n° 14.

SINISTER, ſomething on or towards the left hand. Hence ſome derive the word *ſiniſter*, *à ſinendo*; becauſe the gods, by ſuch auguries, permit us to proceed in our deſigns.

SINISTER, is ordinarily uſed among us for unlucky; though, in the ſacred rites of divination, the Romans uſed it in an oppoſite ſenſe. Thus *avis ſiniſtra*, or a bird on the left hand, was eſteemed a happy omen: whence,

Sinister ‖ Sipontum.

in the law of the 12 tables, *Ave ſiniſtra populi magiſter eſto.*

SINISTER, in heraldry. The ſiniſter ſide of an eſcutcheon is the left-hand ſide; the ſiniſter chief, the left angle of the chief; the ſiniſter baſe, the left-hand part of the baſe.

SINISTER Aſpect, among aſtrologers, is an appearance of two planets happening according to the ſucceſſion of the ſigns; as Saturn in Aries, and Mars in the ſame degree of gemini.

SINISTRI, a ſect of ancient heretics, thus called becauſe they held the left hand in abhorrence and made it a point of religion not to receive any thing therewith.

SINKING FUND, a proviſion made by parliament, conſiſting of the ſurpluſage of other funds, intended to be appropriated to the payment of the national debt; on the credit of which very large ſums have been borrowed for public uſes. See *NATIONAL Debt* and REVENUE.

SINOPICA TERRA, in natural hiſtory, the name of a red earth of the ochre kind, called alſo *rubrica ſinopica*, and by ſome authors *ſinopis*. It is a very cloſe, compact, and weighty earth, of a fine glowing purple colour. It is of a pure texture, but not very hard, and of an even but duſty ſurface. It adheres firmly to the tongue, is perfectly fine and ſmooth to the touch, does not crumble eaſily between the fingers, and ſtains the hands. It melts very ſlowly in the mouth, is perfectly pure and fine, of an auſtere aſtringent taſte, and ferments violently with aquafortis. It was dug in Cappadocia, and carried for ſale to a city in the neighbourhood called *Sinope*, whence it had its name. It is now found in plenty in the New Jerſeys in America, and is called by the people there *bloodſtone*. Its fine texture and body, with its high florid colour, muſt make it very valuable to painters; and from its aſtringency it will probably be a powerful medicine.

SINOPLE, in heraldry, denotes vert, or green colour in armories.—Sinople is uſed to ſignify love, youth, beauty, rejoicing, and liberty; whence it is that letters of grace, ambition, legitimation, &c. are always ſealed with green wax.

SINUOSITY, a ſeries of bends and turns in arches or other irregular figures, ſometimes jutting out and ſometimes falling in.

SINUS, in anatomy, denotes a cavity in certain bones and other parts, the entrance whereof is very narrow, and the bottom wider and more ſpacious.

SINUS, in ſurgery, a little cavity or ſacculus, frequently formed by a wound or ulcer, wherein pus is collected.

SIPHON. See HYDROSTATICS, n° 25.

SIPHONANTHUS, in botany; a genus of plants belonging to the claſs of *tetrandia* and order of *monogynia*. The corolla is monopetalous, funnel-ſhaped; the tube is very narrow, and much longer than the calyx. There are four berries, each containing one ſeed. There is only one ſpecies, the *indica*.

SIPONTUM, SEPUNTUM, or *SIPUS* (anc. geog.), a town of Apulia, ſo denominated (according to Strabo) from the great quantity of *ſepiæ* or cuttleſiſh that are thrown upon the coaſt. Diomed is ſuppoſed by the ſame author to have been the founder of this place; which appears from Livy to have become a colony of Roman citizens. In the early ages of Chriſtian hierarchy, a biſhop was fixed in this church; but, under the Lombards, his ſee was united to that of Beneventum. Being again ſeparated, Sipontum became an archiepiſcopal dioceſe in 1094, about which time it was ſo ill treated by the Barbarians, that it never recovered its ſplendour, but ſunk into ſuch miſery, that in 1260 it was a mere deſert, from the want of inhabitants, the decay of commerce, and the inſalubrity of the air. Manfred having taken theſe circumſtances into conſideration, began in 1261 to build a new city on the ſea-ſhore, to which he removed the few remaining Sipontines. (See the article MANFREDONIA). Sipontum was ſituated at the diſtance of a mile from the ſhore. Excepting a part of its Gothic cathedral, ſcarce one ſtone of the ancient city now remains upon another.

Sipunculus ‖ Sirens.

SIPUNCULUS, in natural hiſtory, a genus of the *inteſtina* claſs of worms in the Linnæan ſyſtem. Its characters are theſe: the body is round and elongated; the mouth attenuated and cylindrical; and the lateral aperture of the body rugged. There are two ſpecies; one found under ſtones in the European, and the other in the Indian ocean.

SIR, the title of a knight or baronet, which, for diſtinction's ſake, as it is now given indiſcriminately to all men, is always prefixed to the knight's Chriſtian name, either in ſpeaking or writing to them.

SIRCAR, any office under the government in Hindoſtan. It is ſometimes uſed for the ſtate of government itſelf. Likewiſe a province, or any number of Pergunnahs placed under one head in the government books, for conveniency in keeping accounts. In common uſage in Bengal, the under banyans of European gentleman are called *ſircars*.

SIRE, a title of honour formerly given to the king of France as a mark of ſovereignty.

SIRE, was likewiſe anciently uſed in the ſame ſenſe with *ſieur* and *ſeigneur*, and applied to barons, gentlemen, and citizens.

SIRENS, in fabulous hiſtory, certain celebrated ſongſtreſſes who were ranked among the demigods of antiquity. Hyginus places their birth among the conſequences of the rape of Proſerpine. Others make them daughters of the river Acheloüs and one of the muſes*. The number of the Sirens was three; and their names were *Parthenope*, *Lygea*, and *Leucoſia*. Some make them half women and half fiſh; others, half women and half birds. There are antique repreſentations of them ſtill ſubſiſting under both theſe forms. Pauſanias tells us, that the Sirens, by the perſuaſion of Juno, challenged the Muſes to a trial of ſkill in ſinging; and theſe having vanquiſhed them, plucked the golden feathers from the wings of the Sirens, and formed them into crowns, with which they adorned their own heads. The Argonauts are ſaid to have been diverted from the enchantment of their ſongs by the ſuperior ſtrains of Orpheus: Ulyſſes, however, had great difficulty in ſecuring himſelf from ſeduction. See *Odyſ.* lib. xii.

*Ovid. Met. lib. iv.

Pope, in his notes to the twelfth book of the Odyſſey, obſerves, the critics have greatly laboured to explain what was the foundation of this fiction of the Sirens. We are told by ſome, that the Sirens were queens of certain ſmall iſlands named *Sirenuſæ*, that lie near Ca-

præa

Sirens, Siren.

præa in Italy, and chiefly inhabited the promontory of Minerva, upon the top of which that goddeſs had a temple, as ſome affirm, built by Ulyſſes. Here there was a renowned academy, in the reign of the Sirens, famous for eloquence and the liberal ſciences, which gave occaſion to the invention of this fable of the ſweetneſs of the voice and attracting ſongs of the Sirens. But why then are they fabled to be deſtroyers, and painted in ſuch dreadful colours? We are told, that at laſt the ſtudents abuſed their knowledge, to the colouring of wrong, the corruption of manners, and the ſubverſion of government: that is, in the language of poetry, they were feigned to be transformed into monſters, and with their muſic to have enticed paſſengers to their ruin, who there conſumed their patrimonies, and poiſoned their virtues with riot and effeminacy. The place is now called *Maſſa*. Some writers tell us of a certain bay, contracted within winding ſtraits and broken cliffs, which, by the ſinging of the winds and beating of the waters, returns a delightful harmony, that allures the paſſenger to approach, who is immediately thrown againſt the rocks, and ſwallowed up by the violent eddies. Thus Horace, moraliſing, calls idleneſs a *Siren*.

——*Vitanda eſt improba Siren*
Deſidia.——

But the fable may be applied to all pleaſures in general, which, if too eagerly purſued, betray the incautious into ruin; while wiſe men, like Ulyſſes, making uſe of their reaſon, ſtop their ears againſt their inſinuations.

The learned Mr Bryant ſays, that the Sirens were Cuthite and Canaanitiſh prieſts, who had founded temples in Sicily, which were rendered infamous on account of the women who officiated. They were much addicted to cruel rites, ſo that the ſhores upon which they reſided are deſcribed as covered with the bones of men deſtroyed by their artifice. *Virgil. Æneid.* lib. v. v. 864.

All ancient authors agree in telling us, that Sirens inhabited the coaſt of Sicily. The name, according to Bochart, who derives it from the Phœnician language, implies a ſongſtreſs. Hence it is probable, ſays Dr Burney, that in ancient times there may have been excellent ſingers, but of corrupt morals, on the coaſt of Sicily, who, by ſeducing voyagers, gave riſe to this fable. And if this conjecture be well founded, he obſerves, the Muſes are not the only pagan divinities who preſerved their influence over mankind in modern times; for every age has its Sirens, and every Siren her votaries; when beauty and talents, both powerful in themſelves, are united, they become ſtill more attractive.

Siren, in zoology, a genus of animals belonging to the claſs of *amphibia* and the order of *meantes*. It is a biped, naked, and furniſhed with a tail; the feet are brachiated with claws. This animal was diſcovered by Dr Garden in Carolina; it is found in ſwampy and muddy places, by the ſides of pools, under the trunks of old trees that hang over the water. The natives call it by the name of *mud-inguana*. Linnæus firſt apprehended, that it was the larva of a kind of lizard; but as its fingers are furniſhed with claws, and it makes a croaking noiſe, he concluded from theſe properties, as well as from the ſituation of the anus, that it could not be the larva of the lizard, and therefore formed of it a new genus under the name of *ſiren*. He was alſo obliged to eſtabliſh for this uncommon animal a new order called *meantes* or *gliders*: the animals of which are amphibious, breathing by means of gills and lungs, and furniſhed with arms and claws.

Phil. Tranſ. vol. lvi. p. 189.

Sirex ‖ Siſon

SIREX, in zoology, a genus of animals belonging to the claſs of *inſects*, and to the order of *hymenopteræ*. The mouth has two ſtrong jaws; there are two truncated palpi or feelers, filiform antennæ, an exſerted, ſtiff, ſerrated ſting, a ſeſſile, mucronated abdomen, and lanceolated wings. There are ſeven ſpecies.

SIRIUM, in botany; a genus of plants belonging to the claſs of *tetrandria* and order of *monogynia*. The calyx is quadrifid; there is no corolla; the nectarium is quadriphyllous and crowning the throat of the calyx; the germen is below the corolla; the ſtigma is trifid, and the berry trilocular. There is only one ſpecies, the myrtifolium.

SIRIUS, in aſtronomy, a bright ſtar in the conſtellation Canis. See ASTRONOMY, n° 403, &c.

SIRLET (Flavius), an eminent Roman engraver on precious ſtones: his Lacoon, and repreſentations in miniature of antique ſtatues at Rome, are very valuable and ſcarce. He died in 1737.

SIROCCO, a periodical wind which generally blows in Italy and Dalmatia every year about Eaſter. It blows from the ſouth-eaſt by ſouth: it is attended with heat, but not rain; its ordinary period is twenty days, and it uſually ceaſes at ſunſet. When the ſcirocco does not blow in this manner, the ſummer is almoſt free from weſterly winds, whirlwinds, and ſtorms. This wind is prejudicial to plants, drying and burning up the buds; though it hurts not men any otherwiſe than by cauſing an extraordinary weakneſs and laſſitude; inconveniences that are fully compenſated by a plentiful fiſhing, and a good crop of corn on the mountains. In the ſummer time, when the weſterly wind ceaſes for a day, it is a ſign that the ſirocco will blow the day following, which uſually begins with a ſort of whirlwind.

Fortis's Travels into Dalmatia, p. 277.

SISKIN. See FRINGILLA.

SISON, BASTARD-STONE PARSLEY, in botany: A genus of plants belonging to the claſs of *pentandria*, and to the order of *digynia*; and in the natural ſyſtem arranged under the 45th order, *umbellatæ*. The fruit is egg-ſhaped and ſtreaked; the involucra are ſubtetraphyllous. There are ſeven ſpecies; the amomum, inundatum, ſegetum, verticillatum, ſalſum, canadenſe, and ammi. The four firſt are natives of Great Britain. 1. The *amomum*, common barſtard parſley, or field ſtonewort, is a biennial plant about three feet high, growing wild in many places of Britain. Its ſeeds are ſmall, ſtriated, of an oval figure and brown colour. Their taſte is warm and aromatic. Their whole flavour is extracted by ſpirit of wine, which elevates very little of it in diſtillation; and hence the ſpirituous extract has the flavour in great perfection, while the watery extract has very little. A tincture drawn with pure ſpirit is of a green colour. The ſeeds have been eſteemed aperient, diuretic, and carminative; but are little regarded in the preſent practice. 2. The *inundatum*, leaſt water-parſnep. The ſtem is about eight or ten inches high, branched,

2 and

Siſtrum, Siſymbrium.

and creeping: the leaves, below the water, are capillary; above it are pinnated: the umbels are bifid. It grows in ditches and ponds. 3. *Segetum*, corn parſley, or honeywort. The ſtems are numerous, ſlender, ſtriated, branched, and leaning; the leaves are pinnated; the pinnæ are oval, pointed, and ſerrated, ſix or eight pair, and one at the end; the umbels ſmall and drooping; the flowers minute and white. It grows in corn-fields and hedges. 4. *Verticillatum*, verticillate ſiſon, has ſmall leaves in whirls, and capillary; the ſtem is two feet, with few leaves; the common umbel is compoſed of 8 or 10 rays, the partial of 18 or 20; both involucra are compoſed of five or ſix oval acute foliola; the flowers are all hermaphrodite, and the petals white.

SISTRUM, or CISTRUM, a kind of ancient muſical inſtrument uſed by the prieſts of Iſis and Oſiris. It is deſcribed by Spon as of an oval form, in manner of a racket, with three ſticks traverſing it breadthwiſe; which playing freely by the agitation of the whole inſtrument, yielded a kind of ſound which to them ſeemed melodious. Mr Malcolm takes the ſiſtrum to be no better than a kind of rattle. Oiſelius obſerves, that the ſiſtrum is found repreſented on ſeveral medals, and on taliſmans.

SISYMBRIUM, WATER-CRESSES, in botany: A genus of plants belonging to the claſs of *tetradynamia*, and to the order of *ſiliquoſa*; and in the natural ſyſtem ranged under the 39th order, *Siliquoſæ*. The ſiliqua, or pod, opens with valves ſomewhat ſtraight. The calyx and corolla are expanded. There are 29 ſpecies, of which eight are natives of Britain; the naſturtium, or common water-creſs; ſylveſtre, water-rocket; amphibium, water-radiſh; terreſtre, annual water-radiſh; monenſe; ſophia, flixweed; irio, broad-leaved hedge-muſtard.

1. The naſturtium grows on the brinks of rivulets and water ditches. The leaves have from 6 to 8 pair of ſmooth ſucculent and ſeſſile pinnæ; the flowers are ſmall and white, and grow in ſhort ſpikes or tufts. The leaves of water-creſſes have a moderately pungent taſte, emit a quick penetrating ſmell, like that of muſtard ſeed, but much weaker. Their pungent matter is taken up both by watery and ſpirituous menſtrua, and accompanies the aqueous juice, which iſſues copiouſly upon expreſſion. It is very volatile, ſo as to ariſe in great part in diſtillation with rectified ſpirit, as well as with water, and almoſt totally to exhale in drying the leaves, or inſpiſſating by the gentleſt heat to the conſiſtence of an extract, either the expreſſed juice, or the watery or ſpirituous tinctures. Both the inſpiſſated juice, and the watery extract, diſcover to the taſte a ſaline impregnation, and in keeping throw up cryſtalline efflorescences to the ſurface. On diſtilling conſiderable quantities of the herb with water, a ſmall proportion of a ſubtile volatile very pungent oil is obtained. *Lewis's Materia Medica.*

Water-creſſes obtain a place in the Materia Medica for their antiſcorbutic qualities, which have been long very generally acknowledged by phyſicians. They are alſo ſuppoſed to purify the blood and humours, and to open viſceral obſtructions. They are nearly allied to ſcurvy-graſs, but are more mild and pleaſant, and for this reaſon are frequently eaten as ſalad. In the pharmacopœias the juice of this plant is directed with that of ſcurvy-graſs and Seville oranges: and Dr Cullen has remarked, that the addition of acids renders the juices of the plantæ ſiliquoſæ more certainly effectual, by determining them more powerfully to an acceſcent fermentation. *Woodville's Medical Botany*, p. 135.

Siſymbrium || Sitta. *Berkenhout's Synopſis of Natural Hiſtory.*

2. Silveſtre, or water-rocket. The ſtem is weak, branched, and above a foot high. The leaves are pinnated; the pinnæ lance-ſhaped, and ſerrated; the flowers ſmall, and yellow; and grow frequently in ſhallow water.

3. Amphibium, or water-radiſh. The ſtem is firm, erect, and two or three feet high; the leaves are pinnatifid, and ſerrated; the flowers are yellow, and in ſpikes; the pods are ſomewhat oval, and ſhort. It grows in water.

4. Terreſtre, or land-rocket. The leaves are pinnatifid; the pods are filled with ſeed; the root is annual, and white; the ſtem is angular, red-green, and ſmooth.

5. Murale, or wall-rocket. The ſtems are rough, and about eight inches high; the leaves grow on foot-ſtalks, lance-ſhaped, ſmooth, ſinuated, and ſerrated; the flowers are yellow; the pods a little compreſſed, and ſlightly carinated. It grows on ſandy ground in the North, Angleſea, &c.

6. Monenſe, or yellow rocket. The ſtem is ſmooth, and about 6 or 8 inches high; the leaves are pinnatifid; the pinnæ remote, generally 7 pair; the flower is yellow; the petals entire; the calyx is cloſed. It grows in the Iſle of Man.

7. Irio, broad-leaved rocket, or hedge muſtard; the ſtem is ſmooth, and about two feet high; the leaves are broad, naked, pinnated, and halberd ſhaped at the end; the flowers are yellow, and the pods erect. It grows on waſte ground.

8. Sophia, flixweed. The ſtem is firm, branched, and two or three feet high; the leaves are multifid; the ſegments are narrow; the flowers are yellow; the petals much leſs than the calyx; the pods are long, ſtiff, curved, without ſtyle, and erect; the ſeeds are minute, and yellow. It grows on walls, waſte ground, &c.

SISYPHUS, in fabulous hiſtory, one of the deſcendents of Eolus, married Merope, one of the Pleiades, who bore him Glaucus. He reſided at Epyra in Peloponneſus, and was a very crafty man. Others ſay, that he was a Trojan ſecretary, who was puniſhed for diſcovering ſecrets of ſtate; and others again, that he was a notorious robber, killed by Theſeus. However, all the poets agree that he was puniſhed in Tartarus for his crimes, by rolling a great ſtone to the top of a hill, which conſtantly recoiled, and, rolling down inceſſantly, renewed his labour.

SISYRINCHIUM, in botany: A genus of plants belonging to the claſs of *gynandria*, and order of *triandria*; and in the natural ſyſtem ranged under the 6th order, *Enſatæ*. The ſpatha is diphyllous; there are 6 plane petals. The capſule is trilocular and inferior.—There are two ſpecies, the bermudiana and palmifolium.

SITE, denotes the ſituation of an houſe, &c. and ſometimes the ground-plot or ſpot of earth it ſtands on.

SITTA NUTHATCH, in ornithology: A genus belonging to the claſs of *aves*, and order of *picæ*. It is thus characterized by Dr Latham. The bill is for the moſt part ſtraight; on the lower mandible there is a ſmall angle; noſtrils ſmall, covered with briſtles reflected over them; tongue ſhort, horny at the end, and jagged; toes placed three forward and one backward; *Latham's Ornithology*, vol. ii. p. 647, &c.

Sitta || Siva.

the middle toe joined closely at the base to both the outmost; back toe as large as the middle one.—There are 11 species: the europæa, canadensis, carolinensis, jamaicensis, pusilla, major, nævia, surinamensis, cafra, longirostra, and chloris. The europæa, or nuthatch, is in length near five inches three-quarters, in breadth nine inches; the bill is strong and straight, about three-quarters of an inch long; the upper mandible black, the lower white: the irides are hazel; the crown of the head, back, and coverts of the wings, of a fine bluish grey; a black stroke passes over the eye from the mouth: the cheeks and chin are white; the breast and belly of a dull orange-colour; the quill-feathers dusky; the wings underneath are marked with two spots, one white at the root of the exterior quills, the other black at the joint of the bastard-wing; the tail consists of twelve feathers; the two middle are grey, the two exterior feathers tipt with grey; then succeeds a transverse white spot; beneath that the rest is black: the legs are of a pale yellow; the back toe very strong, and the claws large. The female is like the male, but less in size, and weighs commonly 5 or at most 6 drams. The eggs are six or seven in number, of a dirty white, dotted with rufous; these are deposited in some hole of a tree, frequently one which has been deserted by a woodpecker, on the rotten wood mixed with a little moss, &c. If the entrance be too large, the bird nicely stops up part of it with clay, leaving only a small hole for itself to pass in and out by. While the hen is sitting, if any one puts a bit of stick into the hole, she hisses like a snake, and is so attached to her eggs, that she will sooner suffer any one to pluck off her feathers than fly away. During the time of incubation, the male supplies her with sustenance, with all the tenderness of an affectionate mate.

The bird runs up and down the bodies of trees, like the woodpecker tribe; and feeds not only on insects, but nuts, of which it lays up a considerable provision in the hollows of trees. "It is a pretty sight, says Mr Willoughby, to see her fetch a nut out of her hoard, place it fast in a chink, and then, standing above it with its head downwards, striking it with all its force, break the shell, and catch up the kernel. It is supposed not to sleep perched on a twig like other birds; for when confined in a cage, it prefers sleeping in a hole or corner. When at rest it keeps the head down. In autumn it begins to make a chattering noise, being silent for the greatest part of the year." Dr Plott tells us, that this bird, by putting its bill into a crack in the bough of a tree, can make such a violent sound as if it was rending asunder, so that the noise may be heard at least twelve score yards.

SITOPHYLAX, Σιτοφυλαξ, formed from σιτος "corn," and φυλαξ, "keeper," in antiquity, an Athenian magistrate, who had the superintendence of the corn, and was to take care that nobody bought more than was necessary for the provision of his family. By the Attic laws, particular persons were prohibited from buying more than fifty measures of wheat a man; and that such persons might not purchase more, the sitophylax was appointed to see the laws properly executed. It was a capital crime to prevaricate in it. There were 15 of these *sitophylaces*, ten for the city, and five for the Piræus.

SIVA, a name given by the Hindoos to the Supreme Being, when considered as the avenger or destroyer. Sir William Jones has shown that in several respects the character of Jupiter and Siva are the same. As Jupiter overthrew the Titans and giants, so did Siva overthrow the Daityas, or children of Diti, who frequently rebelled against Heaven; and as during the contest the god of Olympus was furnished with lightning and thunderbolts by an eagle, so Brahma, who is sometimes represented riding on the Garuda, or eagle, presented the god of destruction with fiery shafts. Siva also corresponds with the Stygian Jove, or Pluto; for, if we can rely on a Persian translation of the Bhágavat, the sovereign of Pátála, or the infernal regions, is the king of serpents, named *Seshanaga*, who is exhibited in painting and sculpture, with a diadem and sceptre, in the same manner as Pluto. There is yet another attribute of Siva, or Mahádéva, by which he is visibly distinguished in the drawings and temples of Bengal. To destroy, according to the Vedantis of India, the Sufis of Persia, and many philosophers of our European schools, is only to generate and reproduce in another form. Hence the god of destruction is holden in this country to preside over generation, as a symbol of which he rides on a white bull. Can we doubt that the loves and feats of Jupiter Genitor (not forgetting the white bull of Europa), and his extraordinary title of Lapis, for which no satisfactory reason is commonly given, have a connection with the Indian philosophy and mythology?

Siva, Sium. *Asiatic Researches.*

SIUM, Water Parsnep, in botany: A genus of plants belonging to the class of *pentandria*, and order of *digynia*, and in the natural system ranging under the 45th order, *Umbellatæ*. The fruit is a little ovated, and streaked. The involucrum is polyphyllous, and the petals are heart-shaped. There are 12 species; the latifolium, angustifolium, nodiflorum, sisarum, ninsi, rigidius, japonicum, falearica, græcum, siculum, repens, and decumbens. The three first are natives of Britain. 1. The *latifolium*, or great water-parsnep, which grows spontaneously in many places both of England and Scotland on the sides of lakes, ponds, and rivulets. The stalk is erect and furrowed, a yard high or more. The leaves are pinnated with three or four pair of large elliptic pinnæ, with an odd one at the end, all serrated on the edges. The stalk and branches are terminated with erect umbels, which is the chief characteristic of the species. Cattle are said to have run mad by feeding upon this plant. 2. The *anguslifolium*, or narrow-leaved water-parsnep, has pinnated leaves; the axillary umbels are pedunculated, and the general involucrum is pinnatifid. It grows in ditches and rivulets, but is not common. 3. The *nodiflorum*, reclining water-parsnep, has pinnated leaves, but the axillary umbels are sessile. It grows on the sides of rivulets.

The *sium sisarum*, or skirret, is a native of China, but has been for a long time cultivated in Europe, and particularly in Germany. The root is a bunch of fleshy fibres, each of which is about as thick as a finger, but very uneven, covered with a whitish rough bark, and has a hard core or pith running thro' the centre. From the crown of this bunch come several winged leaves, consisting of two or three pair of oblong dentated lobes each, and terminated by an odd one. The stalk rises to about two feet, is set with leaves at the joints, and breaks into branches towards the top, each terminating with an umbel of small white flowers, which are succeeded by striated

Six-clerks || Sixtus.

seeds like those of parsley. Skirrets come nearest to parsneps of any of the esculent roots, both for flavour and nutritive qualities. They are rather sweeter than the parsnep, and therefore to some few palates are not altogether so agreeable.

Mr Margraaf extracted from $\frac{1}{2}$ lb. of skirret root $1\frac{1}{2}$ ounces of pure sugar.

SIX-CLERKS, officers in chancery of great account, next in degree below the twelve masters, whose business is to inrol commissions, pardons, patents, warrants, &c. which pass the great seal, and to transact and file all proceedings by bill, answer, &c. They were anciently *clerici*, and forfeited their places, if they married; but when the constitution of the court began to alter, a law was made to permit them to marry. Stat. 14. and 15. Hen. VIII. cap. 8. They are also solicitors for parties in suits depending in the court of chancery. Under them are 6 deputies and 60 clerks, who, with the under clerks, do the business of the office.

SIX NATIONS. See NIAGARA.

SIXTH, in music, one of the simple original concords, or harmonical intervals. See INTERVAL.

SIXTUS V. (Pope), was born the 13th December 1521, in La Marca, a village in the seigniory of Montalto. His father, Francis Peretti, was a gardener, and his mother a servant maid. He was their eldest child, and was called Felix. At the age of nine he was hired out to an inhabitant of the village to keep sheep; but disobliging his master, he was soon after degraded to be keeper of the hogs. He was engaged in this employment when Father Michael Angelo Selleri, a Franciscan friar, asked the road to Ascoli, where he was going to preach. Young Felix conducted him thither, and struck the father so much with his conversation and eagerness for knowledge, that he recommended him to the fraternity to which he had come. Accordingly he was received among them, invested with the habit of a lay brother, and placed under the sacristan, to assist in sweeping the church, lighting the candles, and other offices of that nature; for which he was to be taught the responses, and the rudiments of grammar. His progress in learning was so surprising, that at the age of 14 he was thought qualified to begin his noviciate, and was admitted the year following to make his profession.

He pursued his studies with such unwearied assiduity, that he was soon reckoned equal to the best disputants. He was ordained priest in 1545, when he assumed the name of Father Montalto; soon after he took his doctor's degree, and was appointed professor of theology at Sienna. It was then that he so effectually recommended himself to Cardinal di Carpi, and his secretary Bossius, that they ever remained his steady friends. Meanwhile the severity and obstinacy of his temper incessantly engaged him in disputes with his monastic brethren. His reputation for eloquence, which was now spread over Italy, about this time gained him some new friends. Among these were the Colonna family, and Father Ghisilieri, by whose recommendation he was appointed inquisitor-general at Venice; but he exercised that office with so much severity, that he was obliged to flee precipitately from that city. Upon this he went to Rome, where he was made procurator-general of his order, and soon after accompanied Cardinal Buon Compagnon into Spain, as a chaplain and consultor to the inquisition. There he was treated with great respect, and liberal offers were made him to induce him to continue in Spain, which, however, he could not be prevailed on to accept. Sixtus.

In the mean time, news were brought to Madrid that Pius IV. was dead, and that Father Ghisilieri, who had been made Cardinal Alexandrino by Paul IV. had succeeded him under the name of Pius V. These tidings filled Montalto with joy, and not without reason, for he was immediately invested by the pontiff with new dignities. He was made general of his order, bishop of St Agatha, was soon after raised to the dignity of cardinal, and received a pension. About this time he was employed by the Pope to draw up the bill of excommunication against Queen Elizabeth.

He began now to cast his eyes upon the papacy; and, in order to obtain it, formed and executed a plan of hypocrisy with unparalleled constancy and success. He became humble, patient, and affable. He changed his dress, his air, his words, and his actions, so completely, that his most intimate friends declared him a new man. Never was there such an absolute victory gained over the passions; never was a fictitious character so long maintained, nor the foibles of human nature so artfully concealed. He courted the ambassadors of every foreign power, but attached himself to the interests of none; nor did he accept a single favour that would have laid him under any peculiar obligation. He had formerly treated his relations with the greatest tenderness, but he now changed his behaviour altogether. When his brother Anthony came to visit him, he lodged him in an inn, and sent him home next day, charging him to inform his family that he was now dead to his relations and the world.

When Pius V. died in 1572, he entered the conclave with the other cardinals, but seemed altogether indifferent about the election, and never left his apartment except to his devotion. When solicited to join any party, he declined it, declaring that he was of no consequence, and that he would leave the choice of a Pope entirely to persons of greater knowledge and experience. When Cardinal Buon Compagnon, who assumed the name of Gregory XIII. was elected, Montalto assured him that he never wished for any thing so much in his life, and that he would always remember his goodness, and the favours he had conferred on him in Spain. But the new Pope treated him with the greatest contempt, and deprived him of his pension. The cardinals also, deceived by his artifices, paid him no greater respect, and used to call him, by way of ridicule, the Roman beast; the ass of La Marca.

He now assumed all the infirmities of old age; his head hung down upon his shoulders; he tottered as he walked, and supported himself on a staff. His voice became feeble, and was often interrupted by a cough so exceedingly severe, that it seemed every moment to threaten his dissolution. He interfered in no public transactions, but spent his whole time in acts of devotion and benevolence. Mean time he constantly employed the ablest spies, who brought him intelligence of every particular.

When Gregory XIII. died in 1585, he entered the conclave with the greatest reluctance, and immediately shut himself up in his chamber, and was no more thought of than if he had not existed. When he went

Sixtus. to maſs, for which purpoſe alone he left his apartment, he appeared perfectly indifferent about the event of the election. He joined no party, yet flattered all.

He knew early that there would be great diviſions in the conclave, and he was aware that when the leaders of the different parties were diſappointed in their own views, they all frequently agreed in the election of ſome old and infirm cardinal, the length of whoſe life would merely enable them to prepare themſelves ſufficiently for the next vacancy. Theſe views directed his conduct, nor was he miſtaken in his hopes of ſucceſs.

Three cardinals, the leaders of oppoſite factions, being unable to procure the election which each of them wiſhed, unanimouſly agreed to make choice of Montalto. When they came to acquaint him with their intention, he fell into ſuch a violent fit of coughing that every perſon thought he would expire on the ſpot. He told them that his reign would laſt but a few days; that, beſides a continual difficulty of breathing, he wanted ſtrength to ſupport ſuch a weight, and that his ſmall experience rendered him very unfit for ſo important a charge. He conjured them all three not to abandon him, but to take the whole weight of affairs upon their own ſhoulders; and declared that he would never accept the mitre upon any other terms: "If you are reſolved," added he, "to make me Pope, it will only be placing yourſelves on the throne. For my part, I ſhall be ſatisfied with the bare title. Let the world call me Pope, and I make you heartily welcome to the power and authority. The cardinals ſwallowed the bait, and exerted themſelves ſo effectually that Montalto was elected. He now pulled off the maſk which he had worn for 14 years. No ſooner was his election ſecured, than he ſtarted from his ſeat, flung down his ſtaff in the middle of the hall, and appeared almoſt a foot taller than he had done for ſeveral years.

When he was aſked, according to cuſtom, if he would accept of the Papacy, he replied, "It is trifling to aſk whether I will accept what I have already accepted.—However, to ſatisfy any ſcruple that may ariſe, I tell you that I accept it with great pleaſure, and would accept another if I could get it; for I find myſelf able, by the Divine aſſiſtance, to manage two papacies." His former complaiſance and humility diſappeared, together with his infirmities, and he now treated all around him with reſerve and haughtineſs. The firſt care of Sixtus V. the name which Montalto aſſumed, was to correct the abuſes, and put a ſtop to the enormities, which were daily committed in every part of the eccleſiaſtical ſtate. The lenity of Gregory's government had introduced a general licentiouſneſs of manners, which burſt forth with great violence, after that Pontiff's death. It had been uſual with former Popes to releaſe delinquents on the day of their coronation, who were therefore accuſtomed to ſurrender themſelves voluntary priſoners immediately after the election of the Pope. At preſent, however, they were fatally diſappointed.—When the governor of Rome and the keeper of St Angelo waited on his Holineſs, to know his intention in this particular, he replied, "What have you to do with pardons, and releaſing of priſoners? Is it not ſufficient that our predeceſſor has ſuffered the judges to remain unemployed theſe 13 years? Shall we alſo ſtain our pontificate with the ſame neglect of juſtice? We have too long ſeen, with inexpreſſible concern, the prodigious degree of wickedneſs that reigns in the ſtate to think of granting pardons. Let the priſoners be brought to a ſpeedy trial, and puniſhed as they deſerve, to ſhow the world that Divine Providence has called us to the chair of St Peter, to reward the good, and chaſtiſe the wicked; that we bear not the ſword in vain, but are the miniſters of God, and a revenger to execute wrath on them that do evil." Sixtus.

He appointed commiſſioners to inſpect the conduct of the judges, diſplaced thoſe who were inclined to lenity, and put others of ſevere diſpoſitions in their room. He offered rewards to any perſon who could convict them of corruption or partiality. He ordered the ſyndics of all the towns and ſigniories to make out a complete liſt of the diſorderly perſons within their diſtricts, and threatened the ſtrapado for the ſmalleſt omiſſion. In conſequence of this edict, the ſyndic of Albino was ſcourged in the market-place, becauſe he had left his nephew, an incorrigible libertine, out of his liſt.

He made very ſevere laws againſt robbers and aſſaſſins. Adulterers, when diſcovered, ſuffered death; and they who willingly ſubmitted to the proſtitution of their wives, a cuſtom then common in Rome, received the ſame puniſhment. He was particularly careful of the purity of the female ſex, and never forgave thoſe who attempted to debauch them.

His execution of juſtice was as prompt as his edicts were rigorous. A Swiſs happening to give a Spaniſh gentleman a blow with his halberd, was ſtruck by him ſo rudely with a pilgrim's ſtaff that he expired on the ſpot. Sixtus informed the governor of Rome that he was to dine early, and that juſtice muſt be executed on the criminal before he ſat down to table. The Spaniſh ambaſſador and four cardinals intreated him not to diſgrace the gentleman by ſuffering him to die on a gibbet, but to order him to be beheaded. "He ſhall be hanged (replied Sixtus), but I will alleviate his diſgrace by doing him the honour to aſſiſt perſonally at his death." He ordered a gibbet to be erected before his own windows, where he continued ſitting during the whole execution. He then called to his ſervants to bring in dinner, declaring that the act of juſtice which he had juſt ſeen had increaſed his appetite. When he roſe from table, he exclaimed, "God be praiſed for the good appetite with which I have dined!"

When Sixtus aſcended the throne, the whole eccleſiaſtical ſtate was infeſted with bands of robbers, who, from their numbers and outrages, were exceedingly formidable; by his prudent and vigorous conduct, however, he in a ſhort time extirpated the whole of theſe banditti.

Nor was the vigour of his conduct leſs conſpicuous in his tranſactions with foreign nations. Before he had been pope two months he quarrelled with Philip II. of Spain, Henry III. of France, and Henry king of Navarre. His intrigues indeed in ſome meaſure influenced all the councils of Europe.

After his acceſſion to the pontificate he ſent for his family to Rome, with expreſs orders that they ſhould appear in a decent and modeſt manner. Accordingly, his ſiſter Camilla came thither, accompanied by her daughter and two grandchildren. Some cardinals, in order to pay court to the pope, went out to meet her, and introduced her in a very magnificent dreſs. Sixtus pretended not to know her, and aſked two or three times.

Sixtus.

times who ſhe was: Upon this one of the cardinals ſaid, "It is your ſiſter, holy father." "I have but one ſiſter (replied Sixtus with a frown), and ſhe is a poor woman at Le Grotte; if you have introduced her in this diſguiſe, I declare I do not know her; yet I think I would know her again, if I ſaw her in the clothes ſhe uſed to wear."

Her conductors at laſt found it neceſſary to carry her to an inn; and ſtrip her of her finery. When Camilla was introduced a ſecond time, Sixtus embraced her tenderly, and ſaid, "Now we know indeed that it is our ſiſter: nobody ſhall make a princeſs of you but ourſelves." He ſtipulated with his ſiſter, that ſhe ſhould neither aſk any favour in matters of government, nor intercede for criminals, nor interfere in the adminiſtration of juſtice; declaring that every requeſt of that kind would meet with a certain refuſal. Theſe terms being agreed to, and punctually obſerved, he made the moſt ample proviſion not only for Camilla but for his whole relations.

This great man was alſo an encourager of learning. He cauſed an Italian tranſlation of the Bible to be publiſhed, which raiſed a good deal of diſcontent among the Catholics. When ſome cardinals reproached him for his conduct in this reſpect, he replied, "It was publiſhed for the benefit of you cardinals who cannot read Latin."

Sixtus died in 1590, after having reigned little more than five years. His death was aſcribed to poiſon, ſaid to have been adminiſtered by the Spaniards; but the ſtory ſeems rather improbable.

It was to the indulgence of a diſpoſition naturally formed for ſeverity, that all the defects of this wonderful man are to be aſcribed. Clemency was a ſtranger to his boſom; his puniſhments were often too cruel, and ſeemed ſometimes to border on revenge. Paſquin was dreſſed one morning in a very naſty ſhirt, and being aſked by Martorio why he wore ſuch dirty linen? replied, that he could get no other, for the pope had made his waſherwoman a princeſs, alluding to Camilla, who had formerly been a laundreſs. The pope ordered ſtrict ſearch to be made for the author of this lampoon, and offered him his life and a thouſand piſtoles if he would diſcover himſelf. The author was ſimple enough to make his appearance and claim the reward. "It is true (ſaid the pope) we made ſuch a promiſe, and we ſhall keep it; your life ſhall be ſpared, and you ſhall receive the money preſently: but we have reſerved to ourſelves the power of cutting off your hands and boring your tongue through, to prevent your being ſo witty for the future." It is needleſs to add, that the ſentence was immediately executed. This, however, is the only inſtance of his reſenting the many ſevere ſatires that were publiſhed againſt him.

But though the conduct of Sixtus ſeldom excites love, it generally commands our eſteem, and ſometimes our admiration. He ſtrenuouſly defended the cauſe of the poor, the widow, and the orphan: he never refuſed audience to the injured, however wretched or forlorn their appearance was. He never forgave thoſe magiſtrates who were capable of partiality or corruption; nor ſuffered crimes to paſs unpuniſhed, whether committed by the rich or the poor. He was frugal, temperate, ſober, and never neglected to reward the ſmalleſt favour which had been conferred on him before his exaltation.

When he mounted the throne, the treaſury was not only exhauſted, but in debt: at his death it contained five millions of gold.

Rome was indebted to him for ſeveral of her greateſt embelliſhments, particularly the Vatican library: it was by him, too, that trade was firſt introduced into the Eccleſiaſtical State.

Siya ghuſh Sizar.

SIYA-GHUSH, the caracal of Buffon, an animal of the cat kind. See FELIS, n° xviii.

SIZAR, or SIZER, in Latin *Sizator*, an appellation by which the loweſt order of ſtudents in the univerſities of Cambridge and Dublin are diſtinguiſhed, is derived from the word *ſize*, which in Cambridge, and probably in Dublin likewiſe, has a peculiar meaning. To *ſize*, in the language of the univerſity, is to get any ſort of victuals from the kitchens, which the ſtudents may want in their own rooms, or in addition to their commons in the hall, and for which they pay the cooks or butchers at the end of each quarter. A ſize of any thing is the ſmalleſt quantity of that thing which can be thus bought: two ſizes, or a part of beef, being nearly equal to what a young perſon will eat of that diſh to his dinner; and a ſize of ale or beer being equal to half an Engliſh pint.

The ſizars are divided into two claſſes, viz. ſubſizatores or ſizars, and ſizatores or proper ſizars. The former of theſe are ſupplied with commons from the table of the fellows and fellow-commoners; and in former times, when theſe were more ſcanty than they are now, they were obliged to ſupply the deficiency by ſizing, as is ſometimes the caſe ſtill. The proper ſizars had formerly no commons at all, and were therefore obliged to ſize the whole. In St John's college they have now ſome commons allowed them for dinner, from a benefaction, but they are ſtill obliged to ſize their ſuppers: in the other colleges they are allowed a part of the fellow-commons, but muſt ſize the reſt; and from being thus obliged to ſize the whole or part of their victuals, the whole order derived the name of *ſizars*.

In Oxford, the order ſimilar to that of ſizar is denominated *ſervitor*, a name evidently derived from the menial duties which they perform. In both univerſities theſe orders were formerly diſtinguiſhed by round caps and gowns of different materials from thoſe of the penſioners or commoners, the order immediately above them. But about 30 years ago the round cap was entirely aboliſhed in both ſeminaries. There is ſtill, however, in Oxford, we believe, a diſtinction in the gowns, and there is alſo a trifling difference in ſome of the ſmall colleges in Cambridge; but in the large colleges the dreſs of the penſioners and ſizars is entirely the ſame.

In Oxford, the ſervitors are ſtill obliged to wait at table on the fellows and gentlemen-commoners; but much to the credit of the univerſity of Cambridge, this moſt degrading and diſgraceful cuſtom was entirely aboliſhed about 10 or 12 years ago, and of courſe the ſizars of Cambridge are now on a much more reſpectable footing than the ſervitors of Oxford.

The ſizars are not upon the foundation, and therefore while they continue ſizars are not capable of being elected fellows; but they may at any time, if they

Size. choose, become penſioners: and they generally ſit for ſcholarſhips immediately before they take their firſt degree. If ſucceſsful, they are then on the foundation, and are entitled to become candidates for fellowſhips when they have got that degree. In the mean time, while they continue ſizars, beſides free commons they enjoy many benefactions, which have been made at different times, under the name of *ſizar's prætor*, *exhibitions*, &c. and the rate of tuition, the rent of rooms, and other things of that ſort within their reſpective colleges, is leſs than to the other orders. But tho' their education is thus obtained at a leſs expence, they are not now conſidered as a menial order; for ſizars, penſioner-ſcholars, and even ſometimes fellow-commoners, mix together with the utmoſt cordiality. It is worthy of remark, that at every period this order has ſupplied the univerſity with its moſt diſtinguiſhed officers; and that many of the moſt illuſtrious members of the church, many of the moſt diſtinguiſhed men in the other liberal profeſſions, have, when under-graduates, been ſizars, when that order was on a leſs reſpectable footing than it is now.

SIZE, the name of an inſtrument uſed for finding the bigneſs of fine round pearls. It conſiſts of thin pieces or leaves, about two inches long, and half an inch broad, faſtened together at one end by a rivet. In each of theſe are round holes drilled of different diameters. Thoſe in the firſt leaf ſerve for meaſuring pearls from half a grain to ſeven grains; thoſe of the ſecond, for pearls from eight grains or two carats to five carats, &c.; and thoſe of the third, for pearls from ſix carats and a half to eight carats and a half.

SIZE, is alſo a ſort of paint, varniſh, or glue, uſed by painters, &c

The ſhreds and parings of leather, parchment, or vellum, being boiled in water and ſtrained, make ſize. This ſubſtance is much uſed in many trades.—The manner of uſing ſize is to melt ſome of it over a gentle fire; and ſcraping as much whiting into it as will juſt colour it, let them be well incorporated together; after which you may whiten frames, &c. with it. After it dries, melt the ſize again, and put more whiting, and whiten the frames, &c. ſeven or eight times, letting it dry between each time: but before it is quite dry, between each waſhing with ſize, you muſt ſmoothe and wet it over with a clean bruſh-pencil in fair water.

To make gold-ſize. Take gum-animi and aſphaltum, of each one ounce; minium, litharge of gold, and amber, of each half an ounce: reduce all into a very fine powder, and add to them four ounces of linſeed-oil, and eight ounces of drying oil: digeſt them over a gentle fire that does not flame, ſo that the mixture may only ſimmer, but not boil; leſt it ſhould run over and ſet the houſe on fire, ſtir it conſtantly with a ſtick till all the ingredients are diſſolved and incorporated, and do not leave off ſtirring till it becomes thick and ropy; after being ſufficiently boiled, let it ſtand till it is almoſt cold, and then ſtrain it through a coarſe linen cloth, and keep it for uſe.—To prepare it for working, put what quantity you pleaſe in a horſe-muſcle ſhell, adding as much oil of turpentine as will diſſolve it; and making it as thin as the bottom of your ſeed-lac varniſh, hold it over a candle, and then ſtrain it through a linen-rag into another ſhell; add to theſe as much vermilion as will make it of a darkiſh red: if it is too thick for drawing, you may thin it with ſome oil of turpentine. The chief uſe of this ſize is for laying on metals. Skating.

The beſt gold-ſize for burniſhing is made as follows: Take fine bole, what quantity you pleaſe; grind it finely on a piece of marble, then ſcrape into it a little beef ſuet; grind all well together; after which mix in a ſmall proportion of parchment-ſize with a double proportion of water, and it is done.

To make ſilver-ſize. Take tobacco-pipe clay in fine powder, into which ſcrape ſome black-lead and a little Genoa ſoap, and grind them all together with parchment ſize as already directed.

SKATING, an exerciſe on ice, both graceful and healthy. Although the ancients were remarkable for their dexterity in moſt of the athletic ſports, yet ſkating ſeems to have been unknown to them. It may therefore be conſidered as a modern invention; and probably it derived its origin in Holland, where it was practiſed, not only as a graceful and elegant amuſement, but as an expeditious mode of travelling when the lakes and canals were frozen up during winter. In Holland long journeys are made upon ſkates with eaſe and expedition; but in general leſs attention is there paid to graceful and elegant movements, than to the expedition and celerity of what is called *journey ſkating*. It is only in thoſe countries where it is conſidered as an amuſement, that its graceful attitudes and movements can be ſtudied; and there is no exerciſe whatever better calculated to ſet off the human figure to advantage. The acquirement of moſt exerciſes may be attained at an advanced period of life; but to become an expert ſkater, it is neceſſary to begin the practice of the art at a very early age. It is difficult to reduce the art of ſkating to a ſyſtem. It is principally by the imitation of a good ſkater that a young practitioner can form his own practice. The Engliſh, though often remarkable for feats of agility upon ſkates, are very deficient in gracefulneſs; which is partly owing to the conſtruction of the ſkates. They are too much curved in the ſurface which embraces the ice, conſequently they involuntarily bring the uſers of them round on the outſide upon a quick and ſmall circle; whereas the ſkater, by uſing ſkates of a different conſtruction, leſs curved, has the command of his ſtroke, and can enlarge or diminiſh the circle according to his own wiſh and deſire. The metropolis of Scotland has produced more inſtances of elegant ſkaters than perhaps any other country whatever; and the inſtitution of a Skating Club about 40 years ago, has contributed not a little to the improvement of this elegant amuſement. We are indebted for this article to a gentleman of that Club, who has made the practice and improvement of ſkating his particular ſtudy; and as the nature of our work will not permit the inſertion of a full treatiſe on ſkating, we ſhall preſent our readers with a few inſtructions.

Thoſe who wiſh to be proficients ſhould begin at an early period of life; and ſhould firſt endeavour to throw off the fear which always attends the commencement of an apparently hazardous amuſement. They will ſoon acquire a facility of moving on the inſide: when they have done this, they muſt endeavour to acquire the movement on the outſide of the ſkates; which is nothing more than throwing themſelves upon the outer edge of the ſkate, and making the balance of their body tend towards that

ſide,

Skating, Skeleton.

side, which will neceſſarily enable them to form a ſemicircle. In this, much aſſiſtance may be derived from placing a bag of lead-ſhot in the pocket next to the foot employed in making the outſide ſtroke, which will produce an artificial poiſe of the body, which afterwards will become natural by practice. At the commencement of the outſide ſtroke, the knee of the employed limb ſhould be a little bended, and gradually brought to a rectilineal poſition when the ſtroke is completed. When the practitioner becomes expert in forming the ſemicircle with both feet, he is then to join them together, and proceed progreſſively and alternately with both feet, which will carry him forward with a graceful movement. Care ſhould be taken to uſe very little muſcular exertion, for the impelling motion ſhould proceed from the mechanical impulſe of the body thrown into ſuch a poſition as to regulate the ſtroke. At taking the outſide ſtroke, the body ought to be thrown forward eaſily, the unemployed limb kept in a direct line with the body, and the face and eyes directly looking forward: the unemployed foot ought to be ſtretched towards the ice, with the toes in a direct line with the leg. In the time of making the curve, the body muſt be gradually, and almoſt imperceptibly, raiſed, and the unemployed limb brought in the ſame manner forward; ſo that, at finiſhing the curve, the body will bend a ſmall degree backward, and the unemployed foot will be about two inches before the other, ready to embrace the ice and form a correſpondent curve. The muſcular movement of the whole body muſt correſpond with the movement of the ſkate, and ſhould be regulated ſo as to be almoſt imperceptible to the ſpectators. Particular attention ſhould be paid in carrying round the head and eyes with a regular and imperceptible motion; for nothing ſo much diminiſhes the grace and elegance of ſkating as ſudden jerks and exertions, which are too frequently uſed by the generality of ſkaters. The management of the arms likewiſe deſerves attention. There is no mode of diſpoſing of them more gracefully in ſkating outſide, than folding the hands into each other, or uſing a muff.

There are various feats of activity and manœuvres uſed upon ſkates; but they are ſo various that we cannot pretend to detail them. Moving on the outſide is the primary object for a ſkater to attain; and when he becomes an adept in that, he will eaſily acquire a facility in executing other branches of the art. There are few exerciſes but will afford him hints of elegant and graceful attitudes. For example, nothing can be more beautiful than the attitude of drawing the bow and arrow whilſt the ſkater is making a large circle on the outſide: the manual exerciſe and military ſalutes have likewiſe a pretty effect when uſed by an expert ſkater.

SKELETON, in anatomy, the dried bones of any animal joined together by wires, or by the natural ligament dried, in ſuch a manner as to ſhow their poſition when the creature was alive.

We have, in the Philoſophical Tranſactions, an account of a human ſkeleton, all the bones of which were ſo united, as to make but one articulation from the back to the os ſacrum, and downwards a little way. On ſawing ſome of them, where they were unnaturally joined, they were found not to cohere throughout their whole ſubſtance, but only about a ſixth of an inch deep all round. The figure of the trunk was crooked, the ſpinæ making the convex, and the inſide of the vertebræ the concave part of the ſegment. The whole had been found in a charnel-houſe, and was of the ſize of a full grown perſon.

Skids ‖ Sky.

SKIDS, or Skeeds, in ſea-language, are long compaſſing pieces of timber, notched below ſo as to fit cloſely upon the wales, extending from the main-wale to the top of the ſide, and retained in this poſition by bolts or ſpike-nails. They are intended for preſerving the planks of the ſide, when any heavy body is hoiſted or lowered.

SKIE (Iſle of). See Sky.

SKIFF, a ſmall boat reſembling a yawl, uſually employed for paſſing rivers.

SKIMMER, black. See Shearbill.

SKIMMIA, in botany: A genus of the *monogynia* order, belonging to the *tetrandria* claſs of plants; and in the natural method ranking under the 40th order, *Perſonatæ*. The calyx is quadripartite; the corolla conſiſts of four concave petals; and the berry contains four ſeeds. There is only one ſpecies, viz. the *Japonica*.

SKIN, in anatomy, the general covering of the body of any animal. See Anatomy, n° 74.

Skin, in commerce, is particularly uſed for the membrane ſtripped off the animal to be prepared by the tanner, ſkinner, parchment-maker, &c. and converted into leather, &c. See Tanning.

SKINNER (Stephen), an Engliſh antiquarian, born in 1622. He travelled, and ſtudied in ſeveral foreign univerſities during the civil wars; and in 1654, returned and ſettled at Lincoln, where he practiſed phyſic with ſucceſs until the year 1667, when he died of a malignant fever. His works were collected in folio in 1671, by Mr Henſhaw, under the title of *Etymologicon Linguæ Anglicanæ*, &c.

SKIPPER, or Saury, a ſpecies of Esox, which ſee.

SKIRMISH, in war, a ſlight engagement between ſmall parties, without any regular order; and is therefore eaſily diſtinguiſhed from a *battle*, which is a general engagement between two armies continued for ſome time.

SKULL, in anatomy, the bony caſe in which the brain is incloſed. See Anatomy, n° 11. &c.

Skull-Cap. See Scutellaria.

SKY, the blue expanſe of air or atmoſphere. For the reaſon of its blue colour and concave figure, ſee Optics.

Sky, one of the greateſt of the Weſtern Iſlands of Scotland, ſo called from *Skianach*, which in the Erſe dialect ſignifies *winged*, becauſe the two promontories of Valerneſs and Troterniſh, by which it is bounded on the north-weſt and north-eaſt, are ſuppoſed to reſemble wings. The iſland lies between the ſhire of Roſs and the weſtern part of Lewis. According to the computation of Mr Pennant, Dr Johnſon, and Dr Campbell, it is 60 miles in length, and nearly the ſame in width where broadeſt; according to others it is 50 miles in length, and in ſome places 30 broad. The iſland of Sky is divided between two proprietors; the ſouthern part belongs to the laird of Macleod, ſaid to be lineally deſcended from Leod ſon to the black prince of Man: the northern diſtrict, or barony of Troterniſh, is the property of Lord Macdonald, whoſe anceſtor was Donald,

Sky. nald, king or lord of the Iſles, and chief of the numerous clan of Macdonalds, who are counted the moſt warlike of all the Highlanders. Sky is part of the ſhire of Inverneſs, and formerly belonged to the dioceſe of the Iſles: on the ſouth it is parted from the main land by a channel three leagues in breadth; tho', at the ferry of Glenelly, it is ſo narrow that a man may be heard calling for the boat from one ſide to the other. Sky is well provided with a variety of excellent bays and harbours.

The face of the country is roughened with mountains, ſome of which are ſo high as to be covered with ſnow on the top at midſummer; in general, their ſides are clothed with heath and graſs, which afford good paſturage for ſheep and black cattle. Between the mountains there are ſome fertile valleys, and the greater part of the land towards the ſea-coaſt is plain and arable. The iſland is well watered with a great number of rivers, above 30 of which afford ſalmon; and ſome of them produce black muſcles in which pearls are bred, particularly the rivers Kilmartin and Ord: Martin was aſſured by the proprietor of the former, that a pearl hath been found in it valued at 20 l. Sterling. Here is alſo a conſiderable number of freſh-water lakes well ſtored with trout and eels. The largeſt of theſe lakes takes its denomination from St Columba, to whom is dedicated a chapel that ſtands upon a ſmall iſle in the middle of the lake. Sky likewiſe affords ſeveral cataracts, that roar down the rocks with great impetuoſity. That the iſland has been formerly covered with woods, appears from the large trunks of fir and other trees daily dug out of the bogs and peat-marſhes in every part of this country.

Statiſtical Account of Scotland, vol. xvi. p. 140.

From the height of the hills, and proximity of the ſea, the air ſeldom continues long of the ſame temperature; ſometimes it is dry, oftener moiſt, and in the latter end of winter and beginning of ſpring cold and piercing; at an average, three days in twelve throughout the year ſcarcely free from rain, far leſs from clouds. Theſe, attracted by the hills, ſometimes break in uſeful and refreſhing ſhowers; at other times ſuddenly burſting, pour down their contents with tremendous noiſe, in impetuous torrents that deluge the plains below, and render the ſmalleſt rivulet impaſſable; which, together with the ſtormy winds ſo common in this country in the months of Auguſt and September, frequently blaſt the hopes, and diſappoint the expectations, of the huſbandman. Snow has been often known to lie on the ground from three to ſeven weeks; and on the higheſt hills, even in the middle of June, ſome ſpots of it are to be ſeen. To this various temperature of the air, and uncertainty of weather, the fevers and agues, headachs, rheumatiſms, colds, and dyſenteries, which are the prevailing diſtempers, may be aſcribed. That it is far, however, from being unwholeſome, is ſufficiently evinced by experience; for the inhabitants are, in general, as ſtrong and healthy, and arrive at as advanced an age, as thoſe who live in milder climates, and under a ſerener ſky. The gout is ſcarcely known in this iſland.

The ſoil is generally black, though it likewiſe affords clay of different colours; ſuch as white, red, and blue, and in ſome places fuller's earth. It is, however, much leſs adapted for agriculture than for paſture, and ſeldom, unleſs in very good years, ſupplies itſelf with a ſufficiency of proviſions. Yet, though the ſoil is not very fertile or rich, it might with proper management be made to produce more plentiful crops. But the generality of the farmers are ſo prejudiced in favour of old cuſtoms, and indeed ſo little inclined to induſtry, that they will not eaſily be prevailed on to change them for better; eſpecially if the alteration or amendment propoſed be attended with expence. Therefore, with reſpect to improvements in agriculture, they are ſtill much in the ſame ſtate as they were 20 or 30 years ago. Ploughs, on a new and improved model, that in compariſon to the advantages derived from them might be had at a moderate expence, have lately been introduced into ſeveral diſtricts around, where their good effects are manifeſt, in improving the crops and diminiſhing the labour of man and beaſt; but the laird of Raaſay and one other gentleman are the only perſons in Portree that have uſed them. The *caſcroim*, a crooked kind of ſpade, is almoſt the only inſtrument for labouring the ground uſed among the ordinary claſs of tenants. The average crops of corn are 8000 bolls.

When Mr Knox viſited this iſland in 1786, the number of inhabitants amounted to 15,000: but ſome gentlemen who reſided there affirmed there were 16,000. It is divided into eight pariſhes, in each of which there is a ſchool, beſides three charity-ſchools in different places.

The minerals found here are lead and iron ore, which, however, have never been wrought to any advantage. Near the village of Sartle, the natives find black and white marcaſites, and variegated pebbles. The Appleſglen, in the neighbourhood of Loch-fallart, produces beautiful agates of different ſizes and colours: ſtones of a purple hue are, after great rains, found in the rivulets: cryſtal, of different colours and forms, abounds in ſeveral parts of the iſland, as well as black and white marble, free-ſtone, lime-ſtone, and talc: ſmall red and white coral is found on the ſouthern and weſtern coaſts in great abundance. The fuel conſiſts chiefly of peat and turf, which are impregnated with iron ore and ſaltpetre; and coal has been diſcovered in ſeveral diſtricts.

The wild birds of all ſorts moſt common in the country are, ſolan geeſe, gulls, cormorants, cranes, wild geeſe, and wild ducks; eagles, crows, ravens, rooks, cuckoos, rails, woodcocks, moor-fowl, partridges, plover, wild pigeons, and blackbirds, owls, hawks, ſnipes, and a variety of ſmall birds. In mild ſeaſons, the cuckoo and rail appear in the latter end of April; the former diſappears always before the end of June; the latter ſometimes not till September. The woodcock comes in October, and frequently remains till March. The tame ſorts of fowl are geeſe, ducks, turkeys, cocks, pullets, and tame pigeons.

The black cattle are here expoſed to all the rigours of the ſevere winter, without any other provender than the tops of the heath and the alga marina; ſo that they appear like mere ſkeletons in the ſpring; though, as the graſs grows up, they ſoon become plump and juicy, the beef being ſweet, tender, and finely interlarded.—The amphibious animals are ſeals and otters. Among the reptiles they reckon vipers, aſps, weaſels, frogs, toads, and three different kinds of ſerpents; the firſt ſpotted black and white, and very poiſonous; the ſecond yellow,

Sky. low, with brown ſpots; and the third of a brown colour, the ſmalleſt and leaſt poiſonous.

Whales and cairbans, or ſun-fiſh, come in ſometimes to the ſounds after their prey, but are rarely purſued with any ſucceſs. The fiſhes commonly caught on the coaſt are herrings, ling, cod, ſcate, haddock, mackerel, lythe, ſye, and dog-fiſh. The average price of ling at home is L. 13, 13 s. *per* ton; when ſold, one by one, if freſh, the price is from 3 d. to 5 d.; if cured, from 5 d. to 7d. The barrel of herrings ſeldom ſells under 19 s. which is owing to the great difficulty of procuring ſalt, even ſometimes at any price; and the ſame cauſe prevents many from taking more than are ſufficient for their own uſe.

The kyle of Scalpe teems with oyſters, in ſuch a manner, that after ſome ſpring-tides, 20 horſe-loads of them are left upon the ſands. Near the village of Bernſtill, the beach yields muſcles ſufficient to maintain 60 perſons *per* day; this providential ſupply helps to ſupport many poor families in times of ſcarcity.

The people are ſtrong, robuſt, healthy, and prolific. They generally profeſs the Proteſtant religion; are honeſt, brave, innocent, and hoſpitable. They ſpeak the language, wear the habit, and obſerve the cuſtoms that are common to all the Hebrides. The meconium in new-born infants is purged away with freſh butter: the children are bathed every morning and evening in water, and grow up ſo ſtrong, that a child of 10 months is able to walk alone: they never wear ſhoes or ſtockings before the age of eight or ten, and night-caps are hardly known; they keep their feet always wet; they lie on beds of ſtraw or heath, which laſt is an excellent reſtorative: they are quick of apprehenſion, ingenious, and very much addicted to muſic and poetry. They eat heartily of fiſh; but ſeldom regale themſelves with fleſh-meat: their ordinary food conſiſts of butter, cheeſe, milk, potatoes, colewort, brochan, and a diſh called *oon*, which indeed is no other than the froth of boiled milk or whey raiſed with a ſtick like that uſed in making chocolate.

A ſort of coarſe woollen cloth called *cloa*, or *caddoes*, the manufacture of their wives, made into ſhort jackets and trouſers, is the common dreſs of the men. The philibeg is rarely worn, except in ſummer and on Sundays; on which days, and ſome other occaſions, thoſe in better circumſtances appear in tartans, a bonnet, and ſhort hoſe, and ſome in a hat, ſhort coat, waiſtcoat, and breeches, of Scotch or Engliſh manufacture. The women are in general very cleanly, and ſo exceſſively fond of dreſs, that many maid-ſervants are often known to lay out their whole wages that way.

There are two fairs held annually at Portree, to which almoſt every part of Sky ſends cattle. The firſt is held in the end of May, and the ſecond in the end of July. The fair commonly continues from Wedneſday till the Saturday following. The commodities which are ſold in theſe are horſes, cows, ſheep, goats, hides, butter, cheeſe, fiſh, and wool. The cattle ſold in theſe fairs ſwim over to the main land through a mile or half a mile of ſea. Thouſands of theſe are yearly exported, at from L. 2 to L. 3 each. Many of them are driven to England, where they are fatted for the market, and counted delicious eating.

In Sky appear many ruins of Daniſh forts, watch-towers, beacons, temples, and ſepulchral monuments. All the forts are known by the term *Dun*; ſuch as Dun-Skudborg, Dun-Derig, Dun-Skerineſs, Dun-David, &c. Sky || Slate.

Sky-Colour. To give this colour to glaſs, ſet in the furnace a pot of pure metal of fritt from rochetta or barilla, but the rochetta fritt does beſt; as ſoon as the metal is well purified, take for a pot of twenty pounds of metal ſix ounces of braſs calcined by itſelf; put it by degrees at two or three times into the metal, ſtirring and mixing it well every time, and diligently ſkimming the metal with a ladle: at the end of two hours the whole will be well mixed, and a proof may be taken; if the colour be found right, let the whole ſtand 24 hours longer in the furnace, and it will then be fit to work, and will prove of a moſt beautiful ſky colour.

SLAB, an outſide ſappy plank or board ſawed off from the ſides of a timber-tree. The word is alſo uſed for a flat piece of marble.

Slab-Line, in ſea-language, a ſmall cord paſſing up behind a ſhip's main-ſail or fore-ſail, and being reeved through a block attached to the lower part of the yard, is thence tranſmitted in two branches to the foot of the ſail, to which it is faſtened. It is uſed to truſs up the ſail as occaſion requires, and more particularly for the convenience of the pilot or ſteerſman, that they may look forward beneath it as the ſhip advances.

SLACK-WATER, in ſea-language, denotes the interval between the flux and reflux of the tide, or between the laſt of the ebb and the firſt of the flood, during which the current is interrupted, and the water apparently remains in a ſtate of reſt.

SLACKEN, in metallurgy, a term uſed by the miners to expreſs a ſpongy and ſemivitrified ſubſtance, which they uſed to mix with the ores of metals, to prevent their fuſion. It is the ſcoria or ſcum ſeparated from the ſurface of the former fuſions of metals. To this they frequently add limeſtone, and ſometimes a kind of coarſe iron-ore, in the running of the poorer gold ores.

SLATE *(Stegania)*, a ſtone of a compact texture and laminated ſtructure, ſplitting into fine plates.

Dr Hill diſtinguiſhes four ſpecies of ſtegania. 1. The whitiſh ſteganium, being a ſoft, friable, ſlaty ſtone, of a tolerably fine and cloſe texture, conſiderably heavy, perfectly dull and deſtitute of brightneſs, variegated with a pale brown or browniſh yellow. This ſpecies is common in many counties of England, lying near the ſurface of the ground. It is generally very full of perpendicular as well as horizontal cavities, many of which are filled up with a ſpar a little purer and more cryſtalline than the reſt; and is commonly uſed for covering houſes. 2. The red ſteganium is a very fine and elegant ſlate, of a ſmooth ſurface, firm and compact texture, conſiderably heavy, and of a very beautiful pale purple, glittering all over with ſmall gloſſy ſpangles: it is compoſed of a multitude of very thin plates or flakes, laid cloſely and evenly over one another, and cohering pretty firmly: this is very common in the northern parts of England, and is much valued as a ſtrong and beautiful covering for houſes. 3. The common blue ſteganium is very well known as an uſeful and valuable ſtone, of a fine ſmooth texture and gloſſy ſurface, moderately heavy, and of a pale greyiſh blue; compoſed of a multi-

Slate ‖ Slavery.

tude of even plates, laid close upon one another, and easily splitting at the commissures of them: this is also very common in the north parts of England, and is used in most places for the covering of houses. There are other species of this slate, viz. the browniſh blue friable steganium, usually called *coal-slate*; the greyish black friable steganium, commonly called *shiver*; and the greyish blue sparkling steganium. 4. The friable, aluminous, black steganium, being the Irish slate of the shops: this is composed of a multitude of thin flakes, laid very evenly and regularly over one another, and splits very regularly at the commissures of them. It is common in many parts of Ireland, and is found in some places in England always lying near the surface in very thick strata. In medicine it is used in hemorrhagies of all kinds with success, and is taken often as a good medicine in fevers.

The island of Eusdale, one of the Hebrides on the west coast of Scotland, is entirely composed of slate. The stratum is 36 feet thick. About two millions and a half, at the rate of twenty shillings per thousand, are sold annually to England, Canada, the West Indies, and Norway.

SLAVE. See SLAVERY.

1 Slavery defined.

SLAVERY is a word, of which though generally understood, it is not easy to give a proper definition. An excellent moral writer has defined it to be "an obligation to labour for the benefit of the master, without the contract or consent of the servant." But may not he be properly called a slave who has given up his freedom to discharge a debt which he could not otherwise pay, or who has thrown it away at a game of hazard? In many nations, debts have been legally discharged in this manner; and in some savage tribes, such is the universal ardour for gaming, that it is no uncommon thing for a man, after having lost at play all his other property, to stake, on a single throw of dice, himself, his wife, and his children (A). That persons who have thus lost their liberty are slaves, will hardly be denied; and surely the infatuated gamester is a slave by his own contract. The debtor, too, if he was aware of the law, and contracted debts larger than he could reasonably expect to be able to pay, may justly be considered as having come under an obligation to labour for the benefit of a master *with his own consent;* for every man is answerable for all the known consequences of his voluntary actions.

This definition of slavery seems to be defective as well as inaccurate. A man may be under an obligation to labour through life for the benefit of a master, and yet that master have no right to dispose of him by sale, or in any other way to make him the property of a third person; but the word *slave*, as used among us, always denotes a person who may be bought and sold like a beast in the market (B). In its original sense, indeed, it was of the same import with *noble, illustrious;* but vast numbers of the people among whom it had that signification being, in the decline of the Roman empire, sold by their countrymen to the Venetians, and by them dispersed over all Europe, the word *slave* came to denote a person in the lowest state of servitude, who was considered as the absolute property of his master. See PHILOLOGY, n° 220. Slavery.

2 Inequalities of rank inevitable.

As nothing can be more evident than that all men have, by the law of nature, an equal right to life, liberty, and the produce of their own labour (see RIGHT, n° 5.), it is not easy to conceive what can have first led one part of them to imagine that they had a right to enslave another. Inequalities of rank are indeed inevitable in civil society; and from them results that servitude which is founded in contract, and is of temporary duration. (See MORAL PHILOSOPHY, n° 141.) He who has much property has many things to attend to, and must be disposed to hire persons to assist and serve him; while those who have little or no property must be equally willing to be hired for that purpose. And if the master be kind, and the servant faithful, they will both be happier in this connection than they could have been out of it. But from a state of servitude, where the slave is at the absolute disposal of his master in all things, and may be transferred without his own consent from one proprietor to another, like an ox or an ass, happiness must be for ever banished. How then came a traffic so unnatural and unjust as that of slaves to be originally introduced into the world?

The common answer to this question is, that it took its rise among savages, who, in their frequent wars with each other, either massacred their captives in cold blood, or condemned them to perpetual slavery. In support of this opinion we have heard it observed, that the Latin word *servus*, which signifies not a *hired* servant, but a *slave*, is derived from *servare*, "to preserve;" and that such men were called *servi*, because they were captives, whose lives were preserved on the condition of their becoming the property of the victor.

3 Origin of slavery.

That slavery had its origin from war, we think extremely probable (C), nor are we inclined to controvert this etymology of the word *servus;* but the traffic in men prevailed almost universally long before the Latin lan-

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(A) Aleam (quod mirere) sobrii inter seria exercent, tanta lucrandi perdendive temeritate, ut cum omnia defecerunt, extremo ac noviſſimo jactu de libertate et corpore contendant. Victus voluntariam servitutem adit; quamvis junior, quamvis robustior, alligari se ac venire patitur.—*Tacitus de Mor. Germ.*

The savages of North America are equally addicted to gaming with the ancient Germans, and the negroes on the Slave Coast of Guinea perhaps still more.

(B) The Roman orator's definition of *slavery*, Parad. V. is as accurate as any that we have seen. "Servitus est obedientia fracti animi et abjecti et arbitrio carentis suo;" whether the unhapppy person fell into that state with or without his own contract or consent.

(C) In the article SOCIETY, the reader will find another account of the origin of slavery, which we think likewise probable, though we have not transferred it to this place; as it would, in our opinion, be wrong to give to one writer what we know to belong to another. It may be proper, however, to observe here, that between the two articles there is no contradiction, as barbarous wars were certainly *one* source of slavery.

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language or Roman name was heard of; and there is no good evidence that it began among ſavages. The word עבד, in the Old Teſtament, which in our verſion is rendered *ſervant*, ſignifies literally a *ſlave*, either born in the family or bought with money, in contradiſtinction to שכיר, which denotes a hired ſervant: and as Noah makes uſe of the word עבד in the curſe which he denounces upon Ham and Canaan immediately after the deluge, it would appear that ſlavery had its origin before that event. If ſo, there can be little doubt but that it began among thoſe violent perſons whom our tranſlators have called *giants* *, though the original word נפלים literally ſignifies *aſſaulters of others*. Thoſe wretches ſeem firſt to have ſeized upon women, whom they forcibly compelled to miniſter to their pleaſures; and from this kind of violence the progreſs was natural to that by which they enſlaved their weaker brethren among the men, obliging them to labour for their benefit, without allowing them fee or reward.

4 Prior to the deluge.

* Gen. vi. 4.

5 Nimrod enſlaved his captives.

After the deluge the firſt dealer in ſlaves ſeems to have been Nimrod. "He began," we are told, "to be a mighty one in the earth, and was a mighty hunter before the Lord." He could not, however, be the firſt hunter of wild beaſts; for that ſpecies of hunting muſt have been practiſed from the beginning; nor is it probable that his dexterity in the chaſe, which was then the univerſal employment, could have been ſo far ſuperior to that of all his contemporaries, as to entitle him to the appellation of the "the mighty hunter before the Lord." Hence moſt commentators have concluded, that he was a hunter of men; an opinion which they think receives ſome countenance from the import of his name, the word *Nimrod* ſignifying a rebel. Whatever be in this, there can be little doubt but that he became a mighty one by violence; for being the ſixth ſon of his father, and apparently much younger than the other five, it is not likely that his inheritance exceeded theirs either in extent or in population. He enlarged it, however, by conqueſt; for it appears from Scripture, that he invaded the territories of Aſhur the ſon of Shem, who had ſettled in Shinar; and obliging him to remove into Aſſyria, he ſeized upon Babylon, and made it the capital of the firſt kingdom in the world. As he had great projects in view, it ſeems to be in a high degree probable that he made bond-ſervants of the captives whom he took in his wars, and employed them in building or repairing the metropolis of his kingdom; and hence we think is to be dated the origin of poſtdeluvian ſlavery.

6 Slavery in the days of Abraham.

That it began thus early can hardly be queſtioned; for we know that it prevailed univerſally in the age of Abraham, who was born within ſeventy years after the death of Nimrod. That patriarch had three hundred and eighteen ſervants or ſlaves, born in his own houſe, and trained to arms, with whom he purſued and conquered the four kings who had taken captive his brother's ſon †. And it appears from the converſation which took place between him and the king of Sodom after the battle, that both believed the conqueror had a right to conſider his priſoners as part of his ſpoil. "Give me (ſays the king) the *perſons*, and take the *goods* to thyſelf." It is indeed evident from numberleſs paſſages of ſcripture, that the domeſtics whom our tranſlators call *ſervants* were in thoſe days univerſally conſidered as the moſt valuable part of their maſter's property, and claſſed with his flocks and herds. Thus when the ſacred hiſtorian deſcribes the wealth of Abraham, he ſays, that "he had ſheep and oxen, and he-aſſes, and men-ſervants, and maid-ſervants, and ſhe-aſſes, and camels." And when Abimelech wiſhed to make ſome reparation to the patriarch for the unintended injury that he had done him, "he took ſheep and oxen, and men-ſervants, and women-ſervants, and gave them unto Abraham, and reſtored to him Sarah his wife." The riches and power of Iſaac and Jacob are eſtimated in the very ſame manner. Of the former it is ſaid, that "the man waxed great, and went forward and grew, until he became very great: for he had poſſeſſion of flocks, and poſſeſſion of herds, and great ſtore of ſervants, ועבדה of ſlaves; and the Philiſtines envied him." The latter, we are told, "increaſed exceedingly, and had much cattle, and maid-ſervants, and men-ſervants, and camels, and aſſes ‡."

† Gen. xiv.

‡ Gen. xii. 16. xx. 14. xxiv. 35. xxvi. 13, 14. xxx. 43.

That the practice of buying and ſelling ſervants thus early begun among the patriarchs deſcended to their poſterity, is known to every attentive reader of the Bible. It was expreſsly authoriſed by the Jewiſh law, in which are many directions how ſuch ſervants were to be treated. They were to be bought only of the heathen; for if an Iſraelite grew poor and ſold himſelf either to diſcharge a debt, or to procure the means of ſubſiſtence, he was to be treated not as a ſlave עבד, but as a hired ſervant שכיר, and reſtored to freedom at the year of Jubilee. "Both thy bond-men and thy bond-maids (ſays Moſes) ſhall be of the heathen that are round about you: of them ſhall ye buy bond-men and bond-maids. And ye ſhall take them as an inheritance for your children after you, to inherit them for a poſſeſſion; they ſhall be your bond-men for ever ‖." Unlimited as the power thus given to the Hebrews over their bond-ſervants of heathen extraction appears to have been, they were ſtrictly prohibited from acquiring ſuch property by any other means than fair purchaſe: "he that *ſtealeth* a man and ſelleth him," ſaid their great lawgiver, "ſhall ſurely be put to death §."

7 Authoriſed by the Moſaic law.

‖ Lev. xxv. 39, 40, 44, 46.

§ Lev. xxi. 16.

Whilſt ſlavery, in a mild form, was permitted among the people of God, a much worſe kind of it prevailed among the heathen nations of antiquity. With other abominable cuſtoms, the traffic in men quickly ſpread from Chaldea into Egypt, Arabia, and over all the eaſt, and by degrees found its way into every known region under heaven (D).

8 Spread over the whole world.

Of this hateful commerce we ſhall not attempt to trace the progreſs thro' every age and country, but ſhall con-

(D) If credit be due to a late account of China, the people of that vaſt empire have never made merchandiſe of men or women. The exception, however, is ſo ſingular, that we ſhould be glad to ſee it better authenticated; for it is apparent from works of the moſt undoubted credit, that over all the other eaſtern countries with which we are acquainted ſlavery has prevailed from time immemorial, and that ſome of the Indian nations make long journeys into Africa for the ſole purpoſe of buying ſlaves.

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tent ourſelves with taking a tranſient view of it among the Greeks and Romans, and a few other nations, in whoſe cuſtoms and manners our readers muſt be intereſted.

9 Slavery among the Greeks and

One can hardly read a book of the Iliad or Odyſſey, without perceiving that, in the age of Homer, all priſoners of war were liable to be treated as ſlaves, and compelled, without regard to their rank, ſex, or years, to labour for their maſters in offices of the vileſt drudgery. So univerſally was this cruel treatment of captives admitted to be the right of the victor, that the poet introduces Hector, in the very act of taking a tender and perhaps laſt farewell of his wife, when it was ſurely his buſineſs to afford her every conſolation in his power, telling her, as a thing of courſe which could not be concealed, that, on the conqueſt of Troy, ſhe would be compelled

To bear the victor's hard commands, or bring
The weight of water from Hyperia's ſpring (E).
Pope.

At that early period, the Phœnicians, and probably the Greeks themſelves, had ſuch an eſtabliſhed commerce in ſlaves, that, not ſatisfied with reducing to bondage their priſoners of war, they ſcrupled not to kidnap in cold blood perſons who had never kindled their reſentment, in order to ſupply their foreign markets. In the 14th book of the Odyſſey, Ulyſſes repreſents himſelf as having narrowly eſcaped a ſnare of this kind laid for him by a falſe Phœnician, who had doomed the hero to Libyan ſlavery: and as the whole narrative, in which this circumſtance is told, is an artful fiction, intended to have the appearance of truth to an Ithacan peaſant, the practice of kidnapping ſlaves could not then have appeared incredible to any inhabitant of that iſland.

Such were the manners of the Greeks in the heroic age; nor were they much improved in this reſpect at periods of greater refinement. Philip of Macedon having conquered the Thebans, not only ſold his captives, but even took money for permitting the dead to be buried *; and Alexander, who had more generoſity than Philip, afterwards razed the city of Thebes, and ſold the inhabitants, men, women, and children, for ſlaves †. This cruel treatment of a brave people may indeed be ſuppoſed to have proceeded, in the firſt inſtance, from the avarice of the conqueror; and in the ſecond, from the momentary reſentment of a man who was ſavage and generous by turns, and who had no command of his paſſions. We ſhall not poſitively aſſign it to other cauſes; but from the manner in which the Spartans behaved to their ſlaves, there is little reaſon to imagine that had they received from the Thebans the ſame provocation with Alexander, they would have treated their captives with greater lenity. "At Sparta (ſays a humane and elegant writer) ſlaves were treated with a degree of rigour that is hardly conceivable; although to them, as their huſbandmen and artificers, their proud and idle maſters were indebted for all the neceſſaries of life. The Lacedemonian youth, trained up in the practice of deceiving and butchering thoſe poor men, were from time to time let looſe upon them, in order to ſhow their proficiency in ſtratagem and maſſacre. And once, without any provocation, and merely for their own amuſement, we are told that they murdered three thouſand in one night, not only with the connivance of law, but by its avowed permiſſion. Such, in promoting the happineſs of one part of ſociety and the virtue of another, are the effects of ſlavery."

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* *Juſtin. lib. iii. cap. 4.*
† *Juſtin et Arrian.*
Beattie's Moral Science, vol. ii.

It has been ſaid, that in Athens and Rome ſlaves were better treated than in Sparta: but in the former city their treatment cannot have been good, nor their lives comfortable, where the Athenians reliſhed that tragedy of Euripides in which Hecuba, the wife of Priam, is introduced as lamenting that ſhe was chained like a dog at Agamemnon's gate! Of the eſtimation in which ſlaves were held in Rome, we may form a tolerable notion from the well known fact, that one of thoſe unhappy beings was often chained at the gate of a great man's houſe, to give admittance to the gueſts invited to a feaſt*. In the early periods of the commonwealth it was cuſtomary, in certain ſacred ſhews exhibited on ſolemn occaſions, to drag through the circus a ſlave, who had been ſcourged to death holding in his hand a fork in the form of a gibbet †. But we need not multiply proofs of the cruelty of the Romans to their ſlaves. If the inhuman combats of the gladiators (ſee GLADIATORS) admit of any apology on account of the martial ſpirit with which they were thought to inſpire the ſpectators, the conduct of Vedius Pollio muſt have proceeded from the moſt wanton and brutal cruelty. This man, who flouriſhed not in the earlieſt periods of the republic, when the Romans were little better than a ſavage banditti, but in the poliſhed age of Auguſtus, frequently threw ſuch ſlaves as gave him the ſlighteſt offence into his fiſh-ponds to fatten his lampreys; and yet he was ſuffered to die in peace! The emperor, indeed, upon coming to the knowledge of his cruelty, ordered his lampreys to be deſtroyed, and his ponds to be filled up; but we do not recollect that any other puniſhment was inflicted on the ſavage maſter. Till the reign of the ſame emperor the depoſitions of ſlaves were never admitted in the courts of judicature; and then they were received only when perſons were accuſed of treaſonable practices.

10 Romans.

* *Kames's Sketches.*
† *Cicero de Div.* lib. i. cap. 26.

11 Origin of Roman ſlavery.

The origin of ſlavery in Rome was the ſame as in every other country. Priſoners of war were of courſe reduced to that ſtate, as if they had been criminals. The dictator Camillus, one of the moſt accompliſhed generals of the republic, ſold his Hetrurian captives to pay the Roman ladies for the jewels which they had preſented to Apollo. Fabius, whoſe cautious conduct ſaved his country when Hannibal was victorious in Italy, having ſubdued Tarentum, reduced 30,000 of the citizens to ſlavery, and ſold them to the higheſt bidder. Coriolanus, when driven from Rome, and fighting for the Volſci, ſcrupled not to make ſlaves of his own countrymen; and Julius Cæſar, among whoſe faults wanton cruelty

(E) In thoſe early times drawing water was the office of the meaneſt ſlaves. This appears from Joſhua's curſe upon the Gibeonites who had deceived him.—"Now therefore ye are curſed, and there ſhall none of you be freed from being bond-men, and hewers of wood, and drawers of water, for the houſe of my God." To this ſtate of bondage Homer makes Hector ſay, that Andromache would *neceſſarily* be brought upon the deſtruction of Troy; χαλιρη δ' επικεισετ' αναγκη.—*Il. lib.* vi.

Slavery. cruelty has never been reckoned, ſold at one time fifty-three thouſand captives for ſlaves. Nor did the ſlaves in Rome conſiſt only of foreigners taken in war. By one of the laws of the twelve tables, creditors were empowered to ſeize their inſolvent debtors, and keep them in their houſes till, by their ſervices or labour, they had diſcharged the ſum they owed: and in the beginning of the commonwealth they were authoriſed to ſell ſuch debtors, and even to put them to death (F). The children of ſlaves were the property not of the commonwealth, or of their own parents, but of their maſters; and thus was ſlavery perpetuated in the families of ſuch unhappy men as fell into that ſtate, whether through the chance of war or the cruelty of a fordid creditor (G). The conſequence was, that the number of ſlaves belonging to the rich Patricians was almoſt incredible. Caius Cæcilius Iſidorus, who died about ſeven years before the Chriſtian era, left to his heirs 4116 ſlaves; and if any one of thoſe wretched creatures made an unſucceſsful attempt to regain his liberty, or was even ſuſpected of ſuch a deſign, he was marked on the forehead with a red hot iron (H). In Sicily, during the moſt flouriſhing periods of the commonwealth, it ſeems to have been cuſtomary for maſters to mark their ſlaves in this manner; at leaſt we know that ſuch was the practice of Damophilus, who, not ſatisfied with this ſecurity, ſhut up his ſlaves every night in cloſe priſons, and led them out like beaſts in the morning to their daily labour in the field. Hence aroſe the ſervile war in Sicily.

12 Its duration. Though many laws were enacted by Auguſtus and other patriotic emperors to diminiſh the power of creditors over their inſolvent debtors; though the influence of the mild ſpirit of Chriſtianity tended much to meliorate the condition of ſlaves, even under Pagan maſters; and though the emperor Adrian made it capital to kill a ſlave without a juſt reaſon; yet this infamous commerce prevailed univerſally in the empire for many ages after the converſion of Conſtantine to the religion of Chriſt. It was not indeed completely aboliſhed even in the reign of Juſtinian; and in many countries which had once been provinces of the empire it continued long after the empire itſelf had fallen to pieces. Slavery.

13 Slavery among the ancient Germans. It has already been obſerved, that among the ancient Germans it was not uncommon for an ardent gameſter to loſe his perſonal liberty by a throw of the dice. This was indeed a ſtrong proof of ſavage manners; but the general condition of ſlaves among thoſe ſavages ſeems to have been much better than among the poliſhed Greeks and Romans. In Germany the ſlaves were generally attached to the ſoil, and only employed in tending cattle, and carrying on the buſineſs of agriculture; for the menial offices of every great man's houſe were performed by his wife and children. Such ſlaves were ſeldom beaten, or chained, or impriſoned. Sometimes indeed they were killed by their maſters in a fit of ſudden paſſion; but none were conſidered as materials of commerce, except thoſe who had originally been freemen, and loſt their freedom by play. Theſe, indeed, the ſucceſsful gameſter was very ready to ſell, both becauſe he felt them an uſeleſs burden, and becauſe their preſence continually put him in mind of that ſtate to which a throw of the dice might one day reduce himſelf.

Such is the account which Tacitus gives ‡ of ſlavery among the ancient Germans. The Anglo-Saxons, however, after they were ſettled in this iſland ſeem not to have carried on that traffic ſo honourably. By a ſtatute of Alfred the Great †, the purchaſe of a *man*, a *horſe*, or an *ox*, without a voucher to warrant the ſale, was ſtrictly forbidden. That law was, doubtleſs, enacted to prevent the *ſtealing* of *men* and cattle; but it ſhows

‡ *De Mor. Germ.* 24. 25.

† *Wilkins's Collection of Laws from Ethelbert to Henry III.*

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(F) After a certain number of citations, the law granted to the debtor thirty days of grace to raiſe the ſum for which he was accountable. The words of the law are: "Æris confeſſi, rebuſque jure judicatis, triginti dies juſti ſunto. Poſt dein manum endojacito.—Vincito aut nervo, aut compedibus." "When the debt is confeſſed, and the trial paſſed, let there be thirty days of forbearance: afterwards lay hands on him; bind him either with a cord or fetters." After the thirty days were expired, if the debtor had not diſcharged the debt, he was led to the prætor, who delivered him over to the mercy of his creditors; theſe bound him and kept him in chains for the ſpace of ſixty days. Afterwards, for three market-days ſucceſſively, the debtor was brought to the tribunal of the prætor; then a public crier proclaimed in the forum the debt for which the priſoner was detained. It often happened, that rich perſons redeemed the priſoner by paying his debts; but if nobody appeared in behalf of the debtor after the third market-day, the creditor had a right to inflict the puniſhments appointed by the law. "Tertiis nundinis capite pœnas dato aut trans Tiberim peregre venumduito;" that is, "Let him on the third market-day be puniſhed with death, or ſold beyond the Tiber as a ſlave." If there were ſeveral creditors, they were allowed, in conſequence of this ſevere law, to divide the body of the priſoner into ſeveral parts, and ſhare it among them in proportion to the ſum which they demanded.

(G) This is evident from the ſtory of Appius and Virginia. See Rome, n° 113.

(H) How capriciouſly and unjuſtly this infamous mark was impreſſed, we learn from the ſtory of Reſtio. This man being proſcribed, and a reward offered for his head by the triumvirs Octavianus, Antony, and Lepidus, concealed himſelf from the fury of the tyrants in the beſt way that he could. A ſlave whom he had marked with the hot iron having found out the place of his retreat, conducted him to a cave, and there ſupported him for ſome time with what he earned by his daily labour. At length a company of ſoldiers coming that way, and approaching the cave, the faithful ſlave, alarmed at the danger his maſter was in, followed them cloſe, and falling upon a poor peaſant, killed him in their preſence, and cut off his head, crying out, "I am now revenged on my maſter for the marks with which he has branded me." The ſoldiers, ſeeing the infamous marks on his forehead, and not doubting but he had killed Reſtio, ſnatched the head out of his hand, and returned with it in all haſte to the triumvirs. They were no ſooner gone, than the ſlave conveyed his maſter to the ſea-ſide, where they had the good luck to find one of Sextius Pompeius's veſſels, which tranſported them ſafe into Sicily.

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14 In England and

us that so late as the ninth or tenth century a man, when fairly purchased, was, in England, as much the property of the buyer as the horse on which he rode, or the ox which dragged his plough. In the same country, now so nobly tenacious of freedom and the rights of man, a species of slavery similar to that which prevailed among the ancient Germans subsisted even to the end of the sixteenth century. This appears from a commission issued by Queen Elizabeth in 1574, for inquiring into the lands and goods of all her *bond-men* and *bond-women* in the counties of Cornwall, Devon, Somerset, and Gloucester, in order to compound with them for their manumission, that they might enjoy their lands and goods as freemen ‖. In Scotland there certainly existed an order of slaves or bond-men, who tilled the ground, were attached to the soil, and with it were transferable from one proprietor to another, at a period so late as the thirteenth century; but when or how those villains, as they were called, obtained their freedom, seems to be unknown to every lawyer and antiquary of the present day. Coalliers and salters were, in the same country, slaves till little more than 20 years ago, that they were manumitted by an act of the British legislature, and restored to the rights of freemen and citizens. Before that period the sons of coalliers could follow no business but that of their fathers; nor were they at liberty to seek employment in any other mines than those to which they were attached by birth, without the consent of the lord of the manor, who, if he had no use for their services himself, transferred them by a written deed to some neighbouring proprietor.

‖ *Kames's Sketches*, book i. sketch 5.

15 Scotland.

16 Slavery among the Carthaginians,

That the savage nations of Africa were at any period of history exempted from this opprobrium of our nature which spread over all the rest of the world, the enlightened reader will not suppose. It is indeed in that vast country that slavery has in every age appeared in its ugliest form. We have already observed, that about the era of the Trojan war, a commerce in slaves was carried on between Phœnicia and Lybia: and the Carthaginians, who were a colony of Phœnicians, and revered the customs, manners, and religion of their parent state, undoubtedly continued the Tyrian traffic in human flesh with the interior tribes of Africa. Of this we might rest assured, although we had no other evidence of the fact than what results from the practice of human sacrifices so prevalent in the republic of Carthage. The genuine instincts of nature are often subdued by dire superstition, but they cannot be wholly eradicated; and the rich Carthaginian, when a human victim was demanded from him to the gods, would be ready to supply the place of his own child by the son of a poor stranger, perfidiously purchased at whatever price. That this was, indeed, a very common practice among them, we learn from the testimony of various historians *, who assure us, that when Agathocles the tyrant of Syracuse had overthrown their generals Hanno and Bomilcar, and threatened Carthage itself with a siege, the people attributed their misfortunes to the just anger of Saturn for having been worshipped, for some years, by the sacrifices of children meanly born and secretly *bought*, instead of those of noble extraction. These substitutions of one offering for another were considered as a profane deviation from the religion of their forefathers; and therefore to expiate the guilt of so horrid an impiety, a sacrifice of two hundred children of the first rank was on that occasion made to the bloody god. As the Carthaginians were a commercial people, we cannot suppose that they purchased slaves only for sacrifices. They undoubtedly condemned many of their prisoners of war to the state of servitude, and either sold them to foreigners, or distributed them among their senators and the leaders of their armies. Hanno, who endeavoured to usurp the supreme power in Carthage whilst that republic was engaged in war with Timoleon in Sicily ‡, armed twenty thousand of his slaves in order to carry his nefarious purpose into execution; and Hannibal, after his decisive victory at Cannæ, sold to the Greeks many of his prisoners whom the Roman senate refused to redeem ¶. That illustrious commander was indeed more humane, as well as more politic, than the generality of his countrymen. Before his days it was customary with the Carthaginians either to massacre their captives in cold blood, that they might never again bear arms against them, or to offer them in sacrifice as a grateful acknowledgment to the gods by whose assistance they believed that they were vanquished; but this was not always done even by their most superstitious or most unprincipled leaders. Among other rich spoils which Agathocles, after his victory already mentioned, found in the camp of Hanno and Bomilcar, were twenty thousand pair of fetters and manacles, which those generals had provided for such of the Sicilian prisoners as they intended to preserve alive and reduce to a state of slavery.

* *Polyb. Q. Curt. Diod. Sic.* See also *Ancient Universal History*, vol. xv.

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‡ *Justin.* lib. xxi. cap. 6. and *Universal History.*

¶ *Tit. Liv. Appian and Zonaras.*

With the ancient state of the other African nations we are but very little acquainted. The Numidians, Mauritanians, Getulians, and Garamantes, are indeed mentioned by the Roman historians, who give us ample details of the battles which they fought in attempting to preserve their national independence; but we have no particular account of their different manners and customs in that age when Rome was disputing with Carthage the sovereignty of the world. All the African states of which we know any thing, were in alliance with one or other of those rival republics; and as the people of those states appear to have been less enlightened than either the Romans or the Carthaginians, we cannot suppose that they had purer morals, or a greater regard for the sacred rights of man, than the powerful nations by whom they were either protected or oppressed. They would, indeed, insensibly adopt their customs; and the ready market which Marius found for the prisoners taken in the town Capsa, although Sallust acknowledges ‡ that the sale was contrary to the laws of war, shows that slavery was then no strange thing to the Numidians. It seems indeed to have prevailed through all Africa from the very first peopling of that unexplored country; and we doubt if in any age of the world the unhappy negro was absolutely secure of his personal freedom, or even of not being sold to a foreign trader.

17 And Numidians.

‡ *Bell. Jug.* cap. 91.

18 Slave-trade with the coast of Guinea begun not by the Portuguese,

It is the common opinion that the practice of making slaves of the negroes is of a very modern date; that it owes its origin to the incursions of the Portuguese on the western coast of Africa; and that but for the cunning or cruelty of Europeans, it would not now exist, and would never have existed. But all this is a complication of mistakes. A learned writer has lately proved, with a force of evidence which admits of no reply *, that from the Coast of Guinea a great trade in slaves was

* *Whitaker's Review of Gibbon's Roman History.*

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19 But by the Arabs at an early period.

was carried on by the Arabs ſome hundreds of years before the Portugueſe embarked in that traffic, or had even ſeen a woolly-headed negro. Even the wandering Arabs of the deſert, who never had any friendly correſpondence with the Chriſtians of Europe, have from time immemorial been ſerved by negro ſlaves. "The Arab muſt be poor indeed (ſays M. Saugnier) not to have at leaſt one negro ſlave. His ſole occupation is the care of the herd. They are never employed in war, but they have it in their power to marry. Their wives, who are captive negreſſes, do all the domeſtic work, and are roughly treated by the Arabian women, and by the Arabs themſelves. Their children are ſlaves like them, and put to all kinds of drudgery." Surely no man whoſe judgement is not completely warped by prejudice, will pretend that thoſe roving tribes of ſavages, ſo remarkable for their independent ſpirit and attachment to ancient cuſtoms, learned to enſlave the negroes from the Europeans. In all probability they have, without interruption, continued the practice of ſlavery from the days of their great anceſtor Iſhmael; and it ſeems evident, that *none of the European nations had ever ſeen a woolly-headed negro till the year* 1100, when the cruſaders fell in with a ſmall party of them near the town of Hebron in Judea, and were ſo ſtruck with the novelty of their appearance, that the army burſt into a general fit of laughter ‖. Long before the cruſades, however, we know with certainty that the natives of Guinea had been expoſed to ſale in foreign countries. In 651 the Mahometan Arabs of Egypt ſo haraſſed the king of Nubia or Ethiopia, who was a Chriſtian, that he agreed to ſend them annually, by way of tribute, a *vaſt number of Nubian or Ethiopian ſlaves* into Egypt. Such a tribute as this at that time, we are told, was more agreeable to the khalif than any other, as the Arabs then made *no ſmall account of thoſe ſlaves* ‡.

Saugnier's and Briſſon's Voyages.

‖ *Malmſbury*, fol. p. 83.

‡ *Modern Univerſal Hiſtory*, vol. i. 525.

The very propoſal of ſuch a tribute, and the eſtimation in which black ſlaves were held in Egypt, ſhows that a commerce in bond-ſervants could not then be a new branch of trade either to the Arabs or the Ethiopians; but the vaſt number which the Ethiopian monarch was now compelled to furniſh every year, induced him to feed this great drain upon his ſubjects from the natives of the neighbouring countries. "He ranged accordingly into all that vaſt *blank of geography* upon the map of the world, the ſpreading boſom of the African continent; and even puſhed through it to its fartheſt extremities in the weſt. He thus brought the blacks of Guinea, for the firſt time, into the ſervice and families of the eaſt; and the ſlaves which he paid in tribute to the Arabs, whether derived from the nearer neighbourhood of Ethiopia, fetched from the mediterranean regions of Africa, or brought from the diſtant ſhores of the Atlantic, were all denominated *Ethiopians*, from the country by which they were conveyed into Egypt ‡. "At this time, therefore, according to Mr Whitaker, began that kind of traffic in human fleſh

‡ *Whitaker's Review.*

"Which ſpoils unhappy Guinea of its ſons."

There are not many authors from whom, in queſtions of antiquity, we differ with greater heſitation; but, as we meet with a female Ethiopian ſlave in the Eunuch of Terence, we cannot help ſuſpecting that Guinea was occaſionally "ſpoiled of its ſons" at a much earlier period. At any rate, from the obſervations made by the European travellers who firſt penetrated into that continent, it appears undeniable that ſlavery muſt have prevailed from time immemorial among ſuch of the tribes as had never carried on any commerce with foreign nations. When Battel firſt viſited the Giagas *, thoſe people had never before ſeen a white man; yet they welcomed him and the Engliſh, with whom he had come, to their country, invited them to bring their goods on ſhore, and without heſitation loaded the ſhip with ſlaves. The Giagas were indeed waging war with the kingdom of Benguela; and being cannibals, who prefer human fleſh to all others, the ſlaves whom they had ſold to the Engliſh were probably priſoners whom they would have killed and eaten if they had not found an opportunity of otherwiſe diſpoſing of them to greater advantage. But as they had not been incited by the Europeans to eat their priſoners, there can be no reaſon to ſuppoſe that by the Europeans they had been firſt induced to ſell them: for we have ſeen that this kind of commerce prevailed in Africa among people much more poliſhed than the Giagas ſo early as in the reign of Jugurtha.

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20 The negroes have enſlaved one another from time immemorial.

* *Modern Univerſal Hiſtory*, vol. xiii. chap. 47. ſect. 2.

That it was not introduced among the negroes either by the Arabs or by the Portugueſe, appears ſtill more evident from the behaviour of the Dahomans at the conqueſt of Whidah, and from the manner in which the people of Angola at the earlieſt ſtage of their foreign trade procured a ſupply of ſlaves for the Portugueſe market. The greater part of the ſlaves whom the Angolans exported from St Paulo de Loanda were brought from interior countries, ſome hundreds of leagues diſtant, where they could not have been regularly purchaſed had that commerce been till then unknown in thoſe countries. The Dahomans, in the beginning of the year 1727, had never ſeen a white man: and when their victorious prince and his army, in their rout through Whidah, firſt met with ſome Europeans in the town of Sabi, they were ſo ſhocked at their complexion and their dreſs, that they were afraid to approach them, and could not be perſuaded that they were men till they heard them ſpeak, and were aſſured by the Whidaneſe that theſe were the merchants who purchaſed all the ſlaves that were ſold in Guinea †. Slavery, therefore, if it prevailed among the Dahomans before that period, could not have been introduced among them by European or Arabian intrigues: but we are aſſured by Snelgrave, who was then in the army, that thoſe people treated their captives with ſuch horrid cruelty as was ſhocking to the natives of the ſea-coaſt, and leaves no room for doubt but that ſlavery had been practiſed among them from the earlieſt ages. A great part of their priſoners were ſacrificed to their gods or eaten by the ſoldiers; and when our author expreſſed to a colonel of the guard ſome ſurpriſe that a prince ſo enlightened as the ſovereign of Dahomy ſhould ſacrifice ſo many men whom he might have ſold to great advantage, he was gravely told, that it had been the cuſtom of their nation, from time immemorial, to offer, after victory, a certain number of priſoners to the gods; and that they ſelected the old men for victims, becauſe they were of leſs value at market, and more dangerous from their experience and cunning, than the young men. To thoſe perſons who fancy that the wars between the African princes are carried on for the ſole purpoſe of ſupplying the European ſhips with ſlaves, it may be proper to remark, that one of the kings of Dahomy ſlaughtered at once not only all the captives ta-

† *Modern Univerſal Hiſtory*, vol. xiii. p. 346, &c.

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ken in war, but alſo 127 priſoners of different kinds, that he might have a ſufficiency of ſkulls to adorn the walls of his palace; though at the very time of that maſſacre he *knew* that there were ſix ſlave-ſhips in the road of Whidah from which he could have got for every prime ſlave a price little ſhort of thirty pounds Sterling ‡.

‡ *Dalzel's Hiſtory of the Kingdom of Dahomy.*

Theſe facts, and numberleſs others which the reader will find detailed in the 13th volume of the Modern Univerſal Hiſtory, by writers who were at the greateſt pains to procure authentic information; who were neither biaſſed by intereſt nor blinded by enthuſiaſm; and who appear to have held the infamous traffic in utter abhorrence—prove beyond the poſſibility of doubt, that ſlavery of the worſt kind muſt have prevailed among all the negro nations before they were viſited either by the Portugueſe or by the Arabs (1). Theſe two nations may indeed have been the firſt who dragged the unhappy negro from his native continent, and made his ſlavery doubly ſevere, by compelling him to labour, without his own conſent, for maſters whom he hardly conſidered as human beings.

On the beginning of this commerce, or the dreadful cruelty with which it has been carried on to the preſent day, it is impoſſible to reflect without horror: but there is ſome conſolation, however ſmall, in knowing that its original authors were not Europeans. The purchaſe of Guinea blacks for ſlaves by foreign nations commenced ages before the Portugueſe had laid that country open to the intercourſe of Europe. Even after they had made many incurſions into it, the inhabitants were as regularly purchaſed for ſlaves by ſome of the adjoining ſtates as they are now by the maritime Europeans.

21 The route by which the Arabs carried on the ſlave trade, *Whitaker's Review*, p. 185.

"The Arabs of Egypt having reduced all the north of Africa, and carrying with them their love of black ſervants, would be ſure to open a ready communication for themſelves to their country. They certainly had one ſo early as 1512, and before the Europeans had any for that purpoſe (K). They went from Barbary by a route that was ſo much practiſed, as to be denominated expreſsly 'the way of the camels.' Meeting together at the town of Cape Cantin, that of Valadie near it, the commercial caravan traverſed the vaſt deſerts, thoſe of Sarra, which run like the tropic of Cancer over them in a long line acroſs the country; to a place of great population called Hoden, the *Waden* or *Hoden* of our maps, and a little to the ſouth-weſt of Cape Blanco. From Hoden they turned to the left, and puſhed directly into the interior of the continent, to reach Tegazza, the *Tagazel* or *Tagaza* of our maps, and lying nearly eaſt of Hoden. Here aſſuredly they did, as the caravan does certainly at this day; and added to the other wares upon their camels a quantity of ſalt from thoſe mines of rock-ſalt, which are extraordinary enough to be noticed as rocks in our maps. This they carried, as they ſtill carry it, to Tanbut, the *Tombut* of the maps, and a town in the heart of the African continent. And from this town they turned on the right for the ſea-coaſt again, and reached it in the great kingdom of Mele, the *Melli* of our maps, to the ſouth of the Gambia, and juſt at the ſpringing as it were of that grand arch of ſea which curves ſo deeply into the body of the land, and conſtitutes the extenſive gulph of Guinea. At Melli and at Tombut they received a meaſure of gold for a meaſure of ſalt. The caravan collects gold at Tombut to the preſent time; but at Melli they purchaſed gold, and alſo ſilver, in pieces as large as pebbles. And at Hoden they had *a great mart for ſlaves*; the blacks being brought thither from the countries adjoining, and bartered away to the traders. Such was the Slave Coaſt and the Gold Coaſt of former days. The ſtaple commodity of Hoden is only transferred now to Whidah; and diverted from the Arabs of Barbary to the Chriſtians of Europe," by whom the negroes are carried to the continent of America or to the Sugar Iſlands in the Weſt Indies. In theſe countries they are all ſold like beaſts in a market; but they experience very different degrees of ſervitude from the different maſters who hold them as property. Such of them as are reconciled to the appearance of white men, or have been born in the European colonies, feel themſelves as happy under a humane maſter as they could be in their native continent (L); and we believe that few of them in ſuch circumſtances have expreſſed a deſire to return."

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22 Which is now tranſferred to the Europeans.

In the French Weſt India iſlands, before the late revolution

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(1) The ſame thing appears from the voyages of M. Saugnier, who had an opportunity of converſing with many tribes of negroes, and who always ſpeaks of ſlavery as an eſtabliſhed practice among them; adding, that ſuch as are ſold for crimes are put to death by their own countrymen if they fly from their maſter. It appears likewiſe in a ſtill more ſtriking light from Dalzel's Hiſtory of Dahomy, where we are told that all the Dahomans, from the loweſt to the higheſt, acknowledge the right of the ſovereign to diſpoſe of their perſons and properties at pleaſure; and where we learn, that the ſovereign himſelf aſſured Mr Abſon the Engliſh governor at Whidah, that all his anceſtors had from time immemorial put to death every priſoner of war whom they could not ſell as a ſlave.

(K) In the year 1442, Anthony Gonſalez, a Portugueſe adventurer, reſtored to their native country ſome Mooriſh priſoners whom he had two years before forcibly carried off from the coaſt of Africa. He landed them at *Rio del-Oro*, and received from the Moors in exchange ten blacks and a quantity of gold duſt. This tranſaction proves, that a commerce in black ſervants was then regularly carried on by the Moors and not by the Portugueſe. So early as the year 1502, the Spaniards began to employ a few negroes in the mines of Hiſpaniola; but in the year following, Ovando, the governor of that iſland, forbade the further importation of them, alleging that they taught the Indians all manner of wickedneſs, and rendered them leſs tractable than formerly: and it was not till the year 1517 that the ſupply of negroes to the Spaniſh American plantations became an eſtabliſhed and regular branch of commerce. *Edward's Hiſtory of the Weſt Indies*, Book IV. Chap. ii.

(L) "I have obſerved many of my ſlaves go on board the veſſel with joy, on my aſſurance that they would be well treated and happy on the plantation where I was going to ſend them. When the Banbarans find that they are truſted by the whites, they never think of making their eſcape, chooſing to be the ſlaves of *Europeans* rather

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volution in the mother country, which has produced in all its dependencies anarchy and maſſacre, the condition of the negro-ſlaves was better than that of the bondmen among the ancient Germans. "Thoſe of them who cultivated the plantations were attached to the ſoil, and could not be drawn off to pay debts, or be ſold ſeparately from the eſtate on which they lived. This gave them a laſting property in their huts and little ſpots of ground, which they might ſafely cultivate without dread of being turned out of poſſeſſion, or transferred contrary to their intereſt and feelings from one proprietor to another. They were under the protection of law as ſoon as they arrived in the colony. Proper miſſionaries were appointed for the purpoſe of training them up to a certain degree of religious knowledge, and ample funds were allotted for the maintenance of thoſe eccleſiaſtics. On ill treatment received from his maſter, or on being deprived of his allowance of food and raiment, the ſlave was directed to apply to the king's attorney, who was obliged to proſecute the maſter forthwith. That officer was alſo bound to proſecute, if by any other means he heard of the abuſe; the law adding as the reaſon, *This we will to be obſerved, to check the abuſe of power in the maſter*‡."

23 Condition of ſlaves in the French Weſt Indies under the old government.

‡ *Ramſay's Eſſay on the Treatment and Converſion of Slaves* ſect. v.

We wiſh it were in our power to ſay, that in the Britiſh Weſt India colonies ſlaves are equally protected by law as they were in the French iſlands under the old government, and that the ſame care is taken of their moral and religious improvement. This, however, we are afraid, cannot be ſaid with truth. In the iſland of Jamaica, before the paſſing of the *conſolidated ſlave act*, not many years ago, a white man, whether proprietor or not, who had killed a negro, or by an act of ſeverity been the cauſe of his death, was, for the firſt offence, intitled to benefit of clergy, and not liable to capital puniſhment till a repetition of the crime. By the preſent law, it is enacted, "That if any perſon, whether owner or ſuperintendant of ſlaves, ſhall be convicted of having, by any act of paſſion or cruelty, occaſioned the death of any negro, it ſhall be capital for the *firſt* offence: and for the greater ſecurity of the property, and as a check on thoſe who may have the puniſhment of ſlaves in their power, it is particularly required, that every ſurgeon or doctor belonging to each eſtate ſhall ſwear to the cauſe of the death of each negro, to the beſt of his knowledge and belief; and if any negro dies, and is interred by the owner or overſeer, without the doctor's having ſeen or been ſent for to ſuch negro, in this caſe, the owner or overſeer cauſing the negro to be ſo interred is liable to a proſecution for ſuch conduct."

24 In the Britiſh iſlands.

M'Neil's Obſervations on the Treatment of Negroes in the Iſland of Jamaica.

This law muſt doubleſs be productive of good effects; but being a colonial act, it cannot have the vigour of the *Code Noir;* nor do we know of any attorney in the iſland who is *obliged* to defend the rights of the negroes, or proſecute the maſter whoſe cruelty has by any means come to his knowledge. The juſtices and veſtry of each pariſh are indeed conſtituted *a council of protection*, for the expreſs purpoſe of making full enquiry into the barbarities exerciſed on ſlaves, and bringing the authors to puniſhment at the public expence; and by a new ſlave-act of Grenada, the juſtices are required annually to nominate three freeholders to be *guardians of the ſlaves*, who are to take an oath to ſee the law duly executed‡. Theſe are benevolent regulations; but we doubt if protection can be ſo promptly afforded by a council of guardians as by an individual attorney who has no other employment. In ſome of the other Britiſh iſlands, we have been confidently told that the unfortunate ſons of Africa have no protection whatever againſt the tyranny of a ſordid owner, or the caprice of a boyiſh overſeer (M); though it is added, that the humanity of many maſters more than ſupplies the want of laws in every reſpect but that of improvement, and that the attachment of others has in them a like effect. In ſome caſes good ſenſe, a regard for their reputation, and a well-informed conviction of their intereſt, induce men to treat their ſlaves with diſcretion and humanity. The ſlaves of many a planter poſſeſs advantages beyond what the labourer even of Britain enjoys†;" yet theſe advantages all depend upon the good will of his maſter; and in no part of the Britiſh colonies are the ſlaves attached to the ſoil. This ſingle circumſtance, together with the total neglect of their moral and religious culture, makes their ſituation much leſs eligible than was that of the French ſlaves under the old government; and affords a ſtriking proof of what the humane author whom we have juſt quoted well obſerves, that "thoſe men and nations whom liberty hath exalted, and who therefore ought to regard it tenderly in others, are conſtantly for reſtraining its bleſſings within their own little circle, and delight more in augmenting the train of their dependants than in adding to the rank of fellow-citizens, or in diffuſing the benefits of freedom among their neighbours."

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‡ *Edwards's Hiſtory of the Weſt Indies*, book iv. chap. 5.

† *Ramſay's Eſſay*, p. 66. and 91.

25 The lawfulneſs of ſlavery inquired into.

Having given this ample detail of the riſe and progreſs of ſlavery in the world, and ſhown that it has prevailed in every age, and under all religions, we ſhall now proceed to enquire whether a practice ſo general be in any inſtance lawful; and if it be, how it muſt be modified, in order to be rendered conſiſtent with the rights of man and the immutable laws of virtue.

That in a ſtate of nature one man has a right to ſeize upon another, and to compel him by force to labour for his ſubſiſtence, is a poſition which we believe has never been ſeriouſly maintained. But independent communities ſtand to each other in the very ſame relation that individuals do in a ſtate of nature; and therefore if in ſuch a ſtate the man of greater bodily ſtrength or mental ſagacity would have no right to convert his weaker neighbour into perſonal property, neither can the

than of a *black man* who would treat them with the greateſt cruelty. *Voyages to the Coaſt of Africa by Meſſrs Saugnier and Briſſon*, p. 332. 335. Engliſh Tranſlation.

(M) In Barbadoes there is ſaid to be a law for the protection of ſlaves, which is the moſt inſolent trifling with juſtice and humanity that the writer of this article has ever ſeen. It is enacted, forſooth, "That if any man ſhall, of *wantonneſs*, or only of *bloody-mindedneſs*, or *cruel intention*, *wilfully kill* a negro or other ſlave, if his own, he ſhall pay into the public treaſury *fifteen pounds Sterling!* See *Dickſon's Letters on Slavery*, p. 4.

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the more powerful and enlightened nation have a right to carry off by force, or entice by fraud, the ſubjects of a weaker and more barbarous community for the purpoſe of reducing them to a ſtate of ſervitude. This is a truth ſo obvious as to admit neither of proof nor of denial.

In thus ſtating the caſe between two independent nations, we have in our eye that traffic in ſlaves which is carried on between the civilized Europeans and the barbarous Africans: and the utmoſt length which we think an apologiſt for that trade can go is to contend, that we may lawfully purchaſe ſlaves in thoſe countries where from time immemorial they have been a common branch of commerce. But the European right to purchaſe cannot be better than the African right to ſell; and we have never yet been informed what gives one African a right to ſell another. Such a right cannot be natural, for the reaſon which we have elſewhere aſſigned (ſee RIGHT): neither can it be adventitious; for adventitious rights are immediately derived from the municipal law, which is the public will of the ſtate. But the ſtate has no authority to deprive an innocent man of his perſonal freedom, or of the produce of his own labour; for it is only to ſecure theſe, by protecting the weak from the violence of the ſtrong, that ſtates are formed, and individuals united under civil government.

26 The common apology for it inſufficient.

It may perhaps be ſaid, that by patiently ſubmitting to governments which authoriſe the traffic in human fleſh, men virtually give up their perſonal liberty, and veſt their governors with a right to ſell them as ſlaves: but no man can veſt another with a right which he poſſeſſes not himſelf; and we ſhall not heſitate to affirm, that in a ſtate of nature, where all have equal rights, no individual can ſubmit himſelf to the abſolute diſpoſal of another without being guilty of the greateſt crime. The reaſon is obvious. From the relation in which men ſtand to one another as fellow-creatures, and to God as their common Creator, there are duties incumbent upon each peculiar to himſelf; in the performance of which he can be guided only by his own reaſon, which was given him for that very purpoſe. But he who renounces his perſonal freedom, and ſubmits unconditionally to the caprice of a maſter, impiouſly attempts to ſet himſelf free from the obligation of that law which is interwoven with his very being, and chooſes a director of his conduct different from that which God has aſſigned him. A man therefore cannot put himſelf in a ſtate of unconditional ſervitude; and what he cannot do for himſelf, he ſurely cannot authorize others to do for him either by a tacit or by an open conſent.

27 No man has a right to give himſelf up to the abſolute diſpoſal of another.

Theſe conſiderations have often made us regret that writers, for whoſe talents and integrity we have the higheſt reſpect, ſhould, without accurately defining what they mean by ſlavery, have peremptorily affirmed, that, conſiſtently with the law of nature men may be reduced to that ſtate as a puniſhment for crimes, or to diſcharge debts which they cannot otherwiſe pay. That a criminal, who has forfeited his life to the laws of his country, may have his puniſhment commuted for hard labour, till death in the courſe of nature ſhall put a period to his terreſtrial exiſtence, is a truth which we apprehend cannot be controverted; but to make ſuch a commutation of puniſhments conſiſtent with the laws of nature and of nature's God, it appears to us that the kind and degree of labour muſt be preciſely aſcertained, and the conduct of the criminal not left to the capricious direction of any individual.

28 What kind of ſlavery may be employed as a puniſhment.

Puniſhments can be juſtly inflicted only for one or other of two ends, or for both. They may be calculated either to reform the criminal or to be a warning to the innocent; and thoſe which moſt effectually anſwer both theſe purpoſes are ſurely to be preferred to ſuch as anſwer but one of them. For this reaſon we conſider hard labour as a much fitter puniſhment for moſt crimes than death: but to intitle it to preference, the kind and degree of the labour muſt be aſcertained by the law; for if theſe circumſtances be omitted, and the offender delivered over as a ſlave to the abſolute diſpoſal and caprice of a private maſter, the labour to which he is condemned, inſtead of operating to his reformation, may be converted into the means of tempting him to the commiſſion of new crimes. A young woman, in the ſtate of ſervitude, would hardly be able to maintain her virtue againſt the ſolicitations of a maſter who ſhould promiſe her liberty or a remiſſion of toil upon her yielding to his deſires; and the felon, who had long been accuſtomed to a life of vagrancy and idleneſs, would not ſtrenuouſly object to the perpetration of any wickedneſs to obtain his freedom, or even a diminution of his daily taſk. Indeed ſuch temptations might be thrown in his way, as human nature could not reſiſt but by means of much better principles than felons can be ſuppoſed to poſſeſs. He might be ſcourged into compliance; or his labour might be ſo increaſed as to make him for a little reſpite eagerly embrace the moſt nefarious propoſal which his maſter could make: for being abſolute property, there is no earthly tribunal to which he could appeal for juſtice; and felons do not commonly ſupport themſelves under trials by pious meditation on a future ſtate.

By reaſoning in this way, we are far from meaning to inſinuate that ſlave-holders in general torture their ſlaves into the commiſſion of crimes. God forbid! Many of them we know to be religious, humane, and benevolent: but they are not infallible; and ſome of them may be inſtigated, ſome of them undoubtedly have been inſtigated, by avarice and other worſe principles, to compel creatures, who are ſo abſolutely their dependents, to execute deeds of darkneſs too hazardous for themſelves. But the morality or immorality of any action, and the moral fitneſs of any ſtate, are to be judged of by their natural tendency, if the one were univerſally practiſed and the other univerſally prevalent (ſee MORAL PHILOSOPHY, n° 156.): and as the natural tendency of abſolute domeſtic ſlavery among ſuch creatures as men is to throw the moſt powerful temptations to vice in the way both of maſter and of ſlave, it muſt be in every inſtance, even when employed as a puniſhment, inconſiſtent with the fundamental principles of moral virtue.

29 Children not the property of their parents.

Some writers indeed have maintained, and the civil law ſeems to ſuppoſe, that children are the property of their parents, and may by them be ſold as ſlaves in caſes of urgent neceſſity: but if we duly conſider how property is acquired (ſee PROPERTY), and attend to the natural conſequences of ſlavery, we ſhall ſoon be convinced that this opinion is very ill founded. The rights of parents reſult from their duties; and it is certainly the duty of that man who has been the inſtrument of bringing into the world an intellectual and moral being,

to

Slavery. to do every thing in his power to render the exiſtence of that being happy both in the preſent life and in that which is to come. If this duty be conſcientiouſly diſcharged, the parent has a manifeſt right to the gratitude, love, and reaſonable obedience, of his child; but he cannot, in conſequence of any duty performed, claim a right to transfer that child as property to the uncontrolled diſpoſal of any private maſter; for this plain reaſon, that the man who is conſidered as the private property of another, cannot reaſonably be ſuppoſed to enjoy happineſs in this world, and is under many temptations to do what muſt neceſſarily render him miſerable in the next. See MORAL PHILOSOPHY, n° 138.

If criminals cannot be lawfully reduced to a ſtate of abſolute private ſlavery, much leſs ſurely can it be lawful to reduce inſolvent debtors and priſoners of war to that ſtate. Many a virtuous man, who has contracted debts with the faireſt proſpect of paying them, has been ſuddenly rendered inſolvent by fire, by ſhipwreck, or by the bankruptcy of others with whom he was neceſſarily engaged in the courſe of his trade. Such a man can be conſidered in no reſpect as criminal. He has been indeed unfortunate; but it would be groſsly unjuſt, as well as ſhockingly cruel, to add to his misfortune by reducing him to a ſtate to which we have juſt ſeen that the vileſt felon cannot be reduced without a violation of the laws of morality. Fraudulent bankrupts indeed, of whom we daily ſee many, might with great propriety and the ſtricteſt juſtice be compelled to extenuate their debts by labouring for the benefit of thoſe whom they have injured; and criminals of other deſcriptions might be made to work for the benefit of the public: but in both caſes the taſk to be performed ſhould be aſcertained by the law, and the perſons of the labourers be protected by the ſtate. If ſuch can be called ſlaves, their ſlavery is undoubtedly conſiſtent with every principle of virtue and religion; for they ſuffer nothing but the due reward of their deeds. Priſoners of war, however, can upon no honeſt principle be reduced even to this ſtate of mitigated bondage; for they are ſo far from incurring guilt by fighting for their country, that even to their enemies their courage and conduct in ſuch a cauſe muſt appear worthy of reward. A victorious general has certainly a right to prevent the priſoners taken in battle from again drawing their ſwords againſt him during the continuance of the war; but there are many ways by which this may be done effectually without chaining the unfortunate captives to the oar, or ſelling them like cattle to private purchaſers, by whom they may be treated with capricious cruelty, and driven to the perpetration of the greateſt crimes.

30 Fraudulent bankrupts may be compelled to labour for the benefit of their creditors.

31 Two objections to our concluſions. To theſe concluſions, and the reaſoning on which they are built, we are aware it may be objected, that if private ſlavery were in every inſtance unlawful and inconſiſtent with the fundamental principles of morality, it would not have prevailed among the ancient patriarchs, and far leſs have been authoriſed by the Jewiſh law.

32 The former anſwered. In reply to this objection, it may be obſerved, that Abraham, Iſaac, and Jacob, though excellent men, were not characters abſolutely perfect; that as their practice does not authoriſe polygamy or inceſt among us, it will not authoriſe the reducing of our fellow-creatures to a ſtate of hopeleſs ſervitude; and that from the circumſtances of the age in which they lived, many things were permitted to them, and were indeed harmleſs, which are forbidden to us, and would now be pernicious. The character of Abraham appears to have been much more perfect than that of his ſon or grandſon; and was certainly equal, if not ſuperior, to that of any other mere man of whom we read either in profane or even in ſacred hiſtory. We are to remember, however, that he was born amidſt idolaters, and was probably an idolater himſelf till enlightened by the inſpiration of Jehovah, and called from his kindred and from his father's houſe. Before his converſion, he muſt have had much cattle and many ſlaves, which conſtituted the riches of that early period; and his caſe would indeed have been peculiarly hard, had he been commanded to diveſt himſelf of his ſervants, and to depart into a ſtrange country very thinly inhabited, without people to protect his flocks and herds from beaſts of prey. Nor would his loſs have contributed in any degree to the benefit of his ſlaves, who, as the ranks of men were then adjuſted, could not long have preſerved their liberty. Had they not been forcibly reduced to their former ſtate by their idolatrous countrymen, which in all probability they would have been, they muſt have ſoon ſubmitted to it, or periſhed by hunger. Let it be remembered, too, that the bond-ſervants of Abraham, though conſtituting the moſt valuable part of his property, were not conſidered as a ſpecies of inferior beings, but were treated rather as childeren than as ſlaves. This is evident from his ſpeaking of the ſteward of his houſe as his heir, when complaining to God of the want of ſeed. Indeed the manner in which this circumſtance is mentioned, ſhows that it was then the general practice to conſider domeſtic ſlaves as members of the family; for the patriarch does not ſay, "I will leave my ſubſtance to this Eliezer of Damaſcus;" but his words are, "Behold to me thou haſt given no ſeed; and, lo! one born in my houſe is *my heir*‡." From this mode of expreſſion we are ſtrongly inclined to think that captives taken in war were in that age of ſimplicity incorporated into the family or tribe of the conqueror, as they are ſaid to be at preſent among the North American Indians, to ſupply the place of thoſe who had fallen in battle. If ſo, ſlavery was then a very mild thing, unattended with the evils which are now in its train, and muſt often have been highly beneficial to the captive.

‡ Gen. xv. 3.

33 Anſwer to the other. The other part of the objection appears at firſt ſight more formidable: but perhaps a little attention to the deſign of the Moſaic economy may enable us to remove it even more completely than this. We need not inform our theological readers, that one great purpoſe for which the poſterity of Abraham were ſeparated from the heathen nations around them, was to preſerve the knowledge of the true God in a world run headlong into idolatry. As idolatry appears to have had ſomething in its forms of worſhip extremely captivating to rude minds, and as the minds of the Iſraelites at the era of their departure from Egypt were exceedingly rude, every method was taken to keep their ſeparation from their idolatrous neighbours as complete as poſſible. With this view they were commanded to ſacrifice the animals which their Egyptian maſters had worſhipped as gods, and were taught to conſider hogs and ſuch other creatures as the heathen offered in ſacrifice, when celebrating their myſtical and magic rites, as too unclean to be eaten or even to be touched. Of this di-

Slavery. ſtinction between clean and unclean beaſts, God himſelf aſſigns the reaſon: "I am the Lord your God (ſays he), who have ſeparated you from other people; ye ſhall therefore put difference between clean and unclean beaſts, and between unclean fowls and clean ‡." For the ſame reaſon they were prohibited from intermarrying with the heathen, or having any tranſaction whatever with them as neighbours; and the ſeven idolatrous nations of Canaan they were ſtrictly commanded to exterminate. "When the Lord thy God (ſays Moſes) ſhall deliver them before thee, thou ſhalt ſmite them, and utterly deſtroy them: thou ſhalt make no covenant with them, nor ſhow mercy unto them: neither ſhalt thou make marriages with them: thy daughter thou ſhalt not give unto his ſon, nor his daughter ſhalt thou take to thy ſon; for they will turn away thy ſon from following me, that they may ſerve other gods†."

‡ Lev. xx. 24, 25, 26.

† Deut. vii. 2, 3, 4.

Under theſe laws, it is plain that no intercourſe whatever could have place between an Iſraelite and a man of any other nation, unleſs the latter was reduced to ſuch a ſtate as that he could neither tempt the former nor practiſe himſelf the rites of his idolatrous worſhip. But the Iſraelites were not ſeparated from the reſt of the world for their own ſakes only: They were intended to be the repoſitories of the lively oracles of God, and gradually to ſpread the light of divine truth thro' other nations, till the fulneſs of time ſhould come, when in Chriſt all things were to be gathered together in one. To anſwer this end, it was neceſſary that there ſhould be ſome intercourſe between them and their Gentile neighbours; but we have ſeen that ſuch an intercourſe could only be that which ſubſiſts between maſters and their ſlaves.

Should this apology for the ſlavery which was authoriſed by the Jewiſh law be deemed fanciful, we beg leave to ſubmit to the conſideration of our readers the following account of that matter, to which the ſame objection will hardly be made. It was morally impoſſible that between nations differing ſo widely in religion, cuſtoms, and manners, as the Jews and Gentiles, peace ſhould for ever reign without interruption; but when wars broke out, battles would be fought, and priſoners would be taken. How were theſe priſoners to be diſpoſed of? Cartels for exchange were not then known: it was the duty of the Iſraelites to prevent their captives from taking up arms a ſecond time againſt them; they could not eſtabliſh them among themſelves either as artificers or as huſbandmen; for their law enjoined them to have no communication with the heathen. There was therefore no other alternative but either to maſſacre them in cold blood, or to reduce them to the condition of ſlaves. It would appear, however, that thoſe ſlaves were raiſed to the rank of citizens, or at leaſt that their burdens were much lightened, as ſoon as they were convinced of the truth of the Moſaic revelation, and received into covenant with God by the rite of circumciſion. They were then admitted to the celebration of the paſſover; concerning which one law was decreed to the ſtranger, and to him that was home-born. Indeed, when we conſider who was the legiſlator of the Jews; when we reflect upon the number of laws enacted to mitigate ſlavery among them, and call to mind the means by which the due execution of all their laws was enforced, (ſee THEOLOGY), we cannot help being of opinion that the heathen, who was reduced to ſlavery in Judea, might be happier, if he pleaſed, than when living as a freeman in his own country. But whether this be ſo or not, is a matter with which we have no concern. On account of the hardneſs of their hearts, and the peculiarity of their circumſtances, many things, of which ſlavery may have been one, were permitted to the Jews, which, if practiſed by Chriſtians, would render them highly guilty. Slave-trade.

After treating thus largely of ſlavery in general, we need not occupy much of the reader's time with the

34
SLAVE-TRADE carried on at preſent by the mer- Slave-trade.
chants of Europe with the natives of Africa. It is well known that the Portugueſe were the firſt Europeans who embarked in this trade, and that their example was ſoon followed by the Dutch and the Engliſh. Of the riſe and progreſs of the Engliſh commerce in ſlaves, the reader will find a ſufficient account in other articles of this work§. That commerce, though long cheriſhed by the government as a ſource of national and colonial wealth, was from its commencement conſidered by the thinking part of the nation as a traffic inconſiſtent with the rights of man, and ſuſpected to be carried on by acts of violence. Theſe ſuſpicions have been gradually ſpread through the people at large, and confirmed, in many inſtances, by evidence incontrovertible. Laws have in conſequence been enacted to make the negroes more comfortable on what is called the middle paſſage, and to protect them againſt the wanton cruelty of their maſters in the Weſt Indies: but the humanity of the nation was rouſed; and not many years ago a number of gentlemen, of the moſt reſpectable characters, finding that no adequate protection can be afforded to perſons in a ſtate of hopeleſs ſervitude, formed themſelves into a ſociety at London, for the purpoſe of procuring a total abolition of the ſlave-trade. That the motives which influence the leading men of this ſociety are of the pureſt kind, cannot, we think, be queſtioned; for their object is to deliver thoſe who had none to help them, and from whom they can expect no other reward for their labours of love than the bleſſings of them who are ready to periſh. To a cauſe ſo truly Chriſtian, who would not pray for ſucceſs? or who but muſt feel the moſt pungent regret, if that ſucceſs has been rendered doubtful, or even been delayed, by the imprudence of ſome of the agents employed by the ſociety? This we apprehend to have been really the caſe. Language calculated only to exaſperate the planters cannot ſerve the negroes; and the legiſlature of Great Britain will never ſuffer itſelf to be forced into any meaſure by the menaces of individuals.

§ See *Company*, vol. v. p. 225. and *Guinea*.

35
In the year 1793, petitions were preſented to parlia- Petitions for the abolition of it.
ment for the abolition of this inhuman traffic, which gave a pleaſing picture of the philanthropy of the nation; but, unfortunately for the cauſe of freedom, it was diſcovered that many of the names ſubjoined to thoſe petitions had been collected by means not the moſt honourable. This diſcovery, perhaps, would never have been made, had not the inſulting epithets indiſcriminately heaped upon the ſlave-holders provoked thoſe men to watch with circumſpection over the conduct of their opponents. The conſequence was, that ſuſpicions of unfair dealing on the part of the petitioners were excited

Slave-trade.

cited in the breasts of many who, though they ardently wished well to the cause, chose not to add their names to those of school-boys under age, and of peasants who knew not what they were subscribing. Let the rights of the Africans be maintained with ardour and firmness; but never let their advocates suppose that the cause of humanity requires the support of artifice. Absolute slavery, in which the actions of one man are regulated by the caprice of another, is a state demonstrably inconsistent with the obvious plan of the moral government of the world. It degrades the mental faculties of the slave, and throws, both in his way and in his master's, temptations to vice almost insurmountable. Let these truths be set in a proper light by those who have doubtless seen them exemplified; and they will surely have their full effect on the minds of a generous, and, we trust, not yet an impious people (N). The trade will be gradually abolished; pains will be taken to cultivate the minds of the West Indian negroes; and the era may be at no great distance when slavery shall cease through all the British dominions.

36 Objection to the abolition

But what benefit, it will be asked, would the negroes of Africa reap from an abolition of the slave trade? Should any thing so wildly incredible happen, as that all the nations of Christendom, in one common paroxysm of philanthropy, should abandon this commerce in servants, which has been prosecuted in all ages, and under all religions; they would only abandon it to those who were originally possessed of it, who still penetrate into the country, and who even push up to Gago at the very head of the slave coast; and leave the wool-headed natives of it to Mahometan masters, in preference to Christian. Under such masters they were in Judea at the time of the crusades. Under such, as we learn from Messrs Saugnier, Brisson, and others, they still are in the deserts of Africa, as well as in the islands of Johanna‡ and Madagascar: and it is universally known that they enslave one another as a punishment for the most whimsical crimes. Among them, indeed, slavery seems to be reduced to a system, and to descend, as it has done in more polished nations, from father to son; for both Saugnier and Wadstrom § speak of particular families of negroes who are exempted from that degrading state by the laws of the country.

‡ *Asiatic Researches*, vol. ii.

§ *Essay on Colonization.*

All this we admit to be true. Most certainly the negroes would not be exempted from the miseries of servitude, though Europe and the West Indies were swallowed up in the ocean. The *customs* of the country, as the king of Dahomy assured Mr Abson §, will be *made* as long as black men shall continue to possess their own territories, in their present state of depravity and ignorance; and these customs appear to involve slavery of the cruellest kind. But if slavery be in itself unlawful, is it a sufficient excuse for our continuing the traffic that it is carried on by the rude negroes and the savage Arabs? Are people, whom we sometimes affect to consider as an inferior order of beings, to furnish examples of conduct to those who boast of their advancements in science, in literature, and in refinement? Or will the benevolent Lord of all things pardon us for oppressing our helpless brethren, merely because they are cruelly oppressed by others? It is indeed true that the natives of Guinea cannot be made really free but by introducing among them the blessings of religion and the arts of civil life; but surely they would have fewer temptations than at present to kidnap one another, or to commence unprovoked wars for the purpose of making captives, were the nations of Europe to abandon the commerce in slaves (O). That commerce, we grant, would be continued by the Arabs, and perhaps by others of the eastern nations; but the same number of people could not be carried off by them alone that is now carried off both by them and by the Europeans.

§ *Dalzel's History.*

37 Of no strength.

Were it indeed possible to put the slave-trade under proper regulations, so as to prevent all kidnapping and unjust wars among the Africans, to supply the markets; and were it likewise to ensure to the negroes in the West Indies mild treatment and religious instruction; we are far from being sure that while the natives of Guinea continue so rude, and their neighbours the Arabs so selfishly savage, it would be proper to abandon at once to hordes of barbarians the whole of this commerce in bond servants. "The trade, which in its present form is a reproach to Britain, might be made to take a new shape, and become ultimately a blessing to thousands of wretches who, left in their native country, would have dragged out a life of miserable ignorance, unknowing the hand that framed them, unconscious of the reason of which they were made capable, and heedless of the happiness laid up for them in store §.

§ *Ramsay's Essay*, p. 292, &c.

Slavery is, indeed, in every form an evil; but it seems to be one of those many evils which, having long prevailed in the world, can be advantageously removed only by degrees, and as the moral cultivation of the slaves may

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(N) We have not insisted upon the impolicy of the slave-trade, or endeavoured to prove that its abolition would be *advantageous* to the sugar-planters; for the planters surely understand their own interest better than those can do, who, having never been in the West Indies, are obliged to content themselves with what information they can glean on the subject from a number of violent and contradictory publications. To countenance slavery under any form is undoubtedly immoral. This we know: and therefore upon this ground only have we opposed the slave-trade, which cannot be continued without preferring interest to virtue.

(O) In a speech which Mr Dalzel says the king of Dahomy made to Mr Abson, when he was informed of what had passed in England on the subject of the slave-trade, are these remarkable words: "In the name of my ancestors and myself, I aver that no Dahoman ever embarked in war merely for the sake of procuring wherewithal to purchase your commodities." With all due respect for his sable majesty, we must take the liberty to question the truth of this solemn averment. That the slave-trade is not the *sole* cause of the Dahoman wars every man will admit, who does not fancy that those people have neither passions nor appetites, but for the commodities of Europe: but the bare affirmation of this bloody despot, who boasted of having killed many thousands at the *customs*, will not convince those who have read either Wadstrom's Essay on Colonization, or the evidence respecting the slave-trade given at the bar of the House of Commons, "that no Dahoman *ever* embarked in war merely to procure slaves to barter for European commodities."

Slave-trade || Sleep-walker.

may enable them to ſupport the rank and diſcharge the duties of free men. This is doubtleſs the reaſon why it was not expreſsly prohibited by the divine Author of our religion, but ſuffered to vaniſh gradually before the mild influence of his Heavenly doctrines. It has vaniſhed before theſe doctrines in moſt countries of Europe; and we truſt that the time is at hand when our traffic in human fleſh with the inhabitants of Africa ſhall ceaſe; and that the period is not very diſtant when the ſlaves in the Weſt Indies ſhall be ſo much improved in moral and religious knowledge, as that they may be ſafely truſted with their own freedom. To ſet them free in their preſent ſtate of ignorance and depravity, is one of the wildeſt propoſals that the ardour of innovation has ever made. Such freedom would be equally ruinous to themſelves and to their maſters; and we may ſay of it what Cicero ſaid of ſome unſeaſonable indulgences propoſed to be granted to the ſlaves in Sicily; *Quæ cum accidunt, nemo eſt, quin intelligat ruere illam rempublicam; hæc ubi veniunt, nemo eſt, qui ullam ſpem ſalutis reliquam eſſe arbitretur.*

38 The abolition ſhould be gradual.

39 Danger of a ſudden manumiſſion of ſlaves.

SLAUGHTER. See MAN-SLAUGHTER, HOMICIDE, MURDER, &c.

SLEDGE, a kind of carriage, without wheels, for the conveyance of very weighty things, as huge ſtones, bells, &c. The ſledge for carrying criminals, condemned for high treaſon, to execution, is called HURDLE. The Dutch have a kind of ſledge on which they can carry a veſſel of any burden by land. It conſiſts of a plank of the length of the keel of a moderate ſhip, raiſed a little behind, and hollow in the middle; ſo that the ſides go a little aſlope, and are furniſhed with holes to receive pins, &c. The reſt is quite even.

SLEDGE is a large ſmith's hammer, to be uſed with both hands: of this there are two ſorts, the up-hand ſledge, which is uſed by under workmen, when the work is not of the largeſt ſort; it is uſed with both the hands before, and they ſeldom raiſe it higher than their head. But the other, which is called the about-ſledge, and which is uſed for battering or drawing out the largeſt work, is held by the handle with both hands, and ſwung round over their heads, at their arm's end, to ſtrike as hard a blow as they can.

SLEEP, that ſtate of the body in which, though the vital functions continue, the ſenſes are not affected by the ordinary impreſſions of external objects. See DREAMS; and PHYSIOLOGY, n° 287.

SLEEP-Walker, one who walks in his ſleep. Many inſtances might be related of perſons who were addicted to this practice; but it will be ſufficient to ſelect one remarkable inſtance from a report made to the Phyſical Society of Lauſanne, by a committee of gentlemen appointed to examine a young man who was accuſtomed to walk in his ſleep.

"The diſpoſition to ſleep-walking ſeems, in the opinion of this committee, to depend on a particular affection of the nerves, which both ſeizes and quits the patient during ſleep. Under the influence of this affection, the imagination repreſents to him the objects that ſtruck him while awake, with as much force as if they really affected his ſenſes; but does not make him perceive any of thoſe that are actually preſented to his ſenſes, except in ſo far as they are connected with the dreams which engroſs him at the time. If, during this ſtate, the imagination has no determined purpoſe, he receives the impreſſion of objects as if he were awake; only, however, when the imagination is excited to bend its attention towards them. The perceptions obtained in this ſtate are very accurate, and, when once received, the imagination renews them occaſionally with as much force as if they were again acquired by means of the ſenſes. Laſtly, theſe academicians ſuppoſe, that the impreſſions received during this ſtate of the ſenſes diſappear entirely when the perſon awakes, and do not return till the return of the ſame diſpoſition in the nervous ſyſtem. Sleep-walker.

"Their remarks were made on the Sieur Devaud, a lad thirteen years and a half old, who lives in the town of Vevey, and who is ſubject to that ſingular affection or diſeaſe called *Somnambuliſm* or ſleep-walking. This lad poſſeſſes a ſtrong and robuſt conſtitution, but his nervous ſyſtem appears to be organiſed with peculiar delicacy, and to diſcover marks of the greateſt ſenſibility and irritability. His ſenſes of ſmell, taſte, and touch, are exquiſite; he is ſubject to fits of immoderate and involuntary laughter, and he ſometimes likewiſe weeps without any apparent cauſe.

"This young man does not walk in his ſleep every night; ſeveral weeks ſometimes paſs without any appearance of a fit. He is ſubject to the diſeaſe generally two nights ſucceſſively, one fit laſting for ſeveral hours. The longeſt are from three to four hours, and they commonly begin about three or four o'clock in the morning.

"The fit may be prolonged, by gently paſſing the finger or a feather over his upper lip, and this ſlight irritation likewiſe accelerates it. Having once fallen aſleep upon a ſtaircaſe, his upper lip was thus irritated with a feather, when he immediately ran down the ſteps with great precipitation, and reſumed all his accuſtomed activity. This experiment was repeated ſeveral times.

"The young Devaud thinks he has obſerved, that, on the evenings previous to a fit, he is ſenſible of a certain heavineſs in his head, but eſpecially of a great weight in his eyelids.

"His ſleep is at all times unquiet, but particularly when the fits are about to ſeize him. During his ſleep, motions are obſervable in every part of his body, with ſtarting and palpitations; he utters broken words, ſometimes ſits up in his bed, and afterwards lies down again. He then begins to pronounce words more diſtinctly, he riſes abruptly, and acts as he is inſtigated by the dream that then poſſeſſes him. He is ſometimes in ſleep ſubject to continued and involuntary motions.

"The departure of the fit is always preceded by two or three minutes of calm ſleep, during which he ſnores. He then awakes rubbing his eyes like a perſon who has ſlept quietly.

"It is dangerous to awaken him during the fit, eſpecially if it is done ſuddenly; for then he ſometimes falls into convulſions. Having riſen one night with the intention of going to eat grapes, he left the houſe, paſſed through the town, and went to a vineyard where he expected good cheer. He was followed by ſeveral perſons, who kept at ſome diſtance from him, one of whom fired a piſtol, the noiſe of which inſtantly awakened him, and he fell down without ſenſe. He was carried home and brought to himſelf, when he recollected very well the having been awakened in the vineyard; but nothing more, except the fright at being found there alone, which had made him ſwoon.

"After the fits he generally feels a degree of laſſitude:

Sleep-walker.

tude: ſometimes, though rarely, of indiſpoſition. At the end of one of thoſe fits, of which the gentlemen of the committee were witneſſes, he was affected with vomitings; but he is always ſoon reſtored.

"When he is awaked, he never for the moſt part recollects any of the actions he has been doing during the fit.

"The ſubject of his dreams is circumſcribed in a ſmall circle of objects, that relate to the few ideas with which at his age his mind is furniſhed; ſuch as his leſſons, the church, the bells, and eſpecially tales of ghoſts. It is ſufficient to ſtrike his imagination the evening before a fit with ſome tale, to direct his ſomnambuliſm towards the object of it. There was read to him while in this ſituation the ſtory of a robber; he imagined the very next moment that he ſaw robbers in the room. However, as he is much diſpoſed to dream that he is ſurrounded with them, it cannot be affirmed that this was an effect of the reading. It is obſerved, that when his ſupper has been more plentiful than uſual, his dreams are more diſmal.

"In their report, the gentlemen of the committee dwell much on the ſtate of this young man's ſenſes, on the impreſſion made upon them by ſtrange objects, and on the uſe they are of to him.

"A bit of ſtrong ſmelling wood produced in him a degree of reſtleſſneſs; the fingers had the ſame effect, whether from their ſmell or their tranſpiration. He knew wine in which there was wormwood by the ſmell, and ſaid that it was not wine for his table. Metals make no impreſſion on him.

"Having been preſented with a little common wine while he was in a ſtate of apathy, and all his motions were performed with languor, he drank of it willingly; but the irritation which it occaſioned produced a deal of vivacity in all his words, motions, and actions, and cauſed him to make involuntary grimaces.

"Once he was obſerved dreſſing himſelf in perfect darkneſs. His clothes were on a large table, mixed with thoſe of ſome other perſons; he immediately perceived this, and complained of it much; at laſt a ſmall light was brought, and then he dreſſed himſelf with ſufficient preciſion. If he is teaſed or gently pinched, he is always ſenſible of it, except he is at the time ſtrongly engroſſed with ſome other thing, and wiſhes to ſtrike the offender; however, he never attacks the perſon who has done the ill, but an ideal being whom his imagination preſents to him, and whom he purſues thro' the chamber without running againſt the furniture, nor can the perſons whom he meets in his way divert him from his purſuit.

"While his imagination was employed on various ſubjects, he heard a clock ſtrike, which repeated at every ſtroke the note of the cuckoo. There are cuckoos here, ſaid he; and, upon being deſired, he imitated the ſong of that bird immediately.

"When he wiſhes to ſee an object, he makes an effort to lift his eyelids; but they are ſo little under his command, that he can hardly raiſe them a line or two, while he draws up his eyebrows; the iris at that time appears fixed, and his eye dim. When any thing is preſented to him, and he is told of it, he always half opens his eyes with a degree of difficulty, and then ſhuts them after he has taken what was offered to him.

"The report infers from theſe facts, and from many others relative to the different ſenſes, that their functions are not ſuſpended as to what the ſleep-walker wiſhes to ſee, that is, as to all thoſe perceptions which accord with the objects about which his imagination is occupied; that he may alſo be diſpoſed to receive thoſe impreſſions, when his imagination has no other object at the time; that in order to ſee, he is obliged to open his eyes as much as he can, but when the impreſſion is once made, it remains; that objects may ſtrike his ſight without ſtriking his imagination, if it is not intereſted in them; and that he is ſometimes informed of the preſence of objects without either ſeeing or touching them.

"Having engaged him to write a theme, ſay the committee, we ſaw him light a candle, take pen, ink, and paper, from the drawer of his table, and begin to write, while his maſter dictated. As he was writing, we put a thick paper before his eyes, notwithſtanding which he continued to write and to form his letters very diſtinctly; ſhowing ſigns, however, that ſomething was incommoding him, which apparently proceeded from the obſtruction which the paper, being held too near his noſe, gave to his reſpiration.

"Upon another occaſion, the young ſomnambuliſt aroſe at five o'clock in the morning, and took the neceſſary materials for writing, with his copy-book. He meant to have begun at the top of a page; but finding it already written on, he came to the blank part of the leaf, and wrote ſome time from the following words, *Fiunt ignari pigritia-ils deviennent ignorans par la pareſſe*; and, what is remarkable, after ſeveral lines he perceived he had forgot the *s* in the word *ignorans*, and had put erroneouſly a double *r* in *pareſſe*; he then gave over writing, to add the *s* he had forgot, and to eraſe the ſuperfluous *r*.

"Another time he had made, of his own accord, a piece of writing, in order, as he ſaid, to pleaſe his maſter. It conſiſted of three kinds of writing, text, half text, and ſmall writ; each of them performed with the proper pen. He drew, in the corner of the ſame paper, the figure of a hat; he then aſked for a penknife to take out a blot of ink which he had made between two letters, and he eraſed it without injuring them. Laſtly, he made ſome arithmetical calculations with great accuracy.

"In order to explain ſome of the facts obſerved by the academicians which we have here mentioned, they eſtabliſh two general obſervations, which reſult from what they have ſaid with reſpect to the ſenſes and the dreams of this ſleep-walker.

"1. That he is obliged to open his eyes, in order to recogniſe objects which he wiſhes to ſee; but the impreſſion once made, although rapidly, is vivid enough to ſuperſede the neceſſity of his opening them again, to view the ſame objects anew; that is, the ſame objects are afterwards preſented to his imagination with as much force and preciſion as if he actually ſaw them.

"2. That his imagination, thus warmed, repreſents to him objects, and ſuch as he figures to himſelf, with as much vivacity as if he really ſaw them; and, laſtly, that all his ſenſes, being ſubordinate to his imagination, ſeem concentrated in the object with which it is occupied, and have at that time no perception of any thing but what relates to that object.

"Theſe two cauſes united ſeem to them ſufficient

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for explaining one of the moſt ſingular facts that occurred to their obſervation, to wit, how the young Devaud can write, although he has his eyes ſhut, and an obſtacle before them. His paper is imprinted on his imagination, and every letter which he means to write is alſo painted there, at the place in which it ought to ſtand on the paper, and without being confounded with the other letters; now it is clear that his hand, which is obedient to the will of his imagination, will trace them on the real paper, in the ſame order in which they are repreſented on that which is pictured in his head. It is thus that he is able to write ſeveral letters, ſeveral ſentences, and entire pieces of writing; and what ſeems to confirm the idea, that the young Devaud writes according to the paper painted on his imagination, is, that a certain ſleep-walker, who is deſcribed in the French *Encyclopédie* (article *Somnambuliſm*), having written ſomething on a paper, another piece of paper of the ſame ſize was ſubſtituted in its ſtead, which he took for his own, and made upon this blank paper the corrections he meant to have made on the other which had been taken away, preciſely in the places where they would have been.

"It appears from the recital of another fact, that Devaud, intending to write at the top of the firſt leaf of a white paper book, *Vevey, le*— ſtopped a moment as if to recollect the day of the month, left a blank ſpace, and then proceeded to *Decembre* 1787; after which he aſked for an almanac: a little book, ſuch as is given to children for a new year's gift, was offered to him; he took it, opened it, brought it near his eyes, then threw it down on the table. An almanac which he knew was then preſented to him; this was in German, and of a form ſimilar to the almanac of Vevey: he took it, and then ſaid, 'What is this they have given me; here, there is your German almanac.' At laſt they gave him the almanac of Berne; he took this likewiſe, and went to examine it at the bottom of an alcove that was perfectly dark. He was heard turning over the leaves, and ſaying 24, then a moment afterwards 34. Returning to his place, with the almanac open at the month of December, he laid it on the table and wrote in the ſpace which he had left blank the 24th. This ſcene happened on the 23d; but as he imagined it to be the 24th, he did not miſtake. The following is the explication given of this fact by the authors of the report.

"The dates 23d, 24th, and 25th, of the month of December, had long occupied the mind of the young Devaud. The 23d and 25th were holidays, which he expected with the impatience natural to perſons of his age, for the arrival of thoſe moments when their little daily labours are to be ſuſpended. The 25th eſpecially was the object of his hopes; there was to be an illumination in the church, which had been deſcribed to him in a manner that quite tranſported him. The 24th was a day of labour, which came very diſagreeably between the two happy days. It may eaſily be conceived, how an imagination ſo irritable as that of the young Devaud would be ſtruck with thoſe pleaſing epochs. Accordingly, from the beginning of the month he had been perpetually turning over the almanac of Vevey. He calculated the days and the hours that were to elapſe before the arrival of his wiſhed-for holidays; he ſhowed to his friends and acquaintance the dates of thoſe days which he expected with ſo much impatience; every time he took up the almanac, it was only to conſult the month of December. We now ſee why that date preſented itſelf to his mind. He was performing a taſk, becauſe he imagined the day to be the Monday which had ſo long engroſſed him. It is not ſurpriſing, that it ſhould have occurred to his imagination, and that on opening the almanac in the dark he might have thought he ſaw this date which he was ſeeking, and that his imagination might have repreſented it to him in as lively a manner as if he had actually ſeen it. Neither is it ſurpriſing that he ſhould have opened the almanac at the month of December; the cuſtom of peruſing this month muſt have made him find it in the dark by a mere mechanical operation. Man never ſeems to be a machine ſo much as in the ſtate of ſomnambuliſm; it is then that habit comes to ſupply thoſe of the ſenſes that cannot be ſerviceable, and that it makes the perſon act with as much preciſion as if all his ſenſes were in the utmoſt activity. Theſe circumſtances deſtroy the idea of there being any thing miraculous in the behaviour of young Devaud with reſpect to the date and the month that he was in queſt of; and the reader, who has entered into our explanations, will not be ſurpriſed at his knowing the German almanac; the touch alone was ſufficient to point it out to him; and the proof of this is the ſhortneſs of the time that it remained in his hands.

"An experiment was made by changing the place of the ink-ſtandiſh during the time that Devaud was writing. He had a light beſide him, and had certified himſelf of the place where his ink-holder was ſtanding by means of ſight. From that time he continued to take ink with preciſion, without being obliged to open his eyes again: but the ink-ſtandiſh being removed, he returned as uſual to the place where he thought it was: It muſt be obſerved, that the motion of his hand was rapid till it reached the height of the ſtandiſh, and then he moved it ſlowly, till the pen gently touched the table as he was ſeeking for the ink: he then perceived that a trick had been put on him, and complained of it; he went in ſearch of his ink-ſtandiſh and put it in its place. This experiment was ſeveral times repeated, and always attended with the ſame circumſtances. Does not what we have here ſtated prove, that the ſtandiſh, the paper, the table, &c. are painted on his imagination in as lively a manner as if he really ſaw them, as he ſought the real ſtandiſh in the place where his imagination told him it ought to have been? Does it not prove that the ſame lively imagination is the cauſe of the moſt ſingular actions of this ſleep-walker? And laſtly, does it not prove, that a mere glance of his eye is ſufficient to make his impreſſions as lively as durable?

"The committee, upon the whole, recommend to ſuch as wiſh to repeat the ſame experiments, 1. To make their obſervations on different ſleep-walkers. 2. To examine often whether they can read books that are unknown to them in perfect darkneſs. 3. To obſerve whether they can tell the hours on a watch in the dark. 4. To remove when they write the ink-ſtandiſh from its place, to ſee whether they will return to the ſame place in order to take ink. 5. And, laſtly, to take notice whether they walk with the ſame confidence in a dark

Sleepers || Sleſwick.

and unknown place, as in one with which they are acquainted.

"They likewiſe recommend to ſuch as would confirm or invalidate the above obſervations, to make all their experiments in the dark; becauſe it has been hitherto ſuppoſed that the eyes of ſleep-walkers are of no uſe to them."

SLEEPERS, in natural hiſtory, a name given to thoſe animals which ſleep all winter; ſuch as bears, marmots, dormice, bats, hedgehogs, ſwallows, &c. Theſe do not feed in winter, have no ſenſible evacuations, breathe little or none at all, and moſt of the viſcera ceaſe from their functions. Some of theſe creatures ſeem to be dead, and others return to a ſtate like that of the fœtus before birth: in this ſtate they continue, till by new heat the fluids are attenuated, the animal is reſtored to life, and the functions begin where they left off.

SLEEPERS, in a ſhip, timbers lying before and aft in the bottom of the ſhip, as the rungheads do: the lowermoſt of them is bolted to the rungheads, and the uppermoſt to the futtocks and rungs.

SLEIDAN (John), an excellent German hiſtorian, born of obſcure parents, in 1506, at Sleidan, a ſmall town on the confines of the duchy of Juliers. After ſtudying ſome time in his own country, together with his townſman the learned John Sturmius, he went to France, and in 1535 entered into the ſervice of the cardinal and archbiſhop John du Bellay. He retired to Straſburg in 1542, where he acquired the eſteem and friendſhip of the moſt conſiderable perſons, particularly of James Sturmius; by whoſe advice and aſſiſtance he was enabled to write the hiſtory of his own time. He was employed in ſome public negociations; but the death of his wife, in 1555, plunged him into ſo deep a melancholy, that he loſt his memory entirely, and died the year following. In 1555 came out, in folio, *De ſtatu Religionis et Reipublicæ ſub Carolo Quinto*, &c. in 25 books; from the year 1517, when Luther began to preach, to the year of its publication; which hiſtory was preſently tranſlated into moſt of the languages of Europe. Beſides this great work, he wrote, *De quatuor ſummis Imperiis, libri tres*; with ſome other hiſtorical and political pieces.

SLEIGHT *of* HAND. See LEGERDEMAIN.

SLEUT-HOUNDE, the ancient Scots name of the blood-hound. The word is from the Saxon *ſlot*, "the impreſſion that a deer leaves of its foot in the mire," and *hound* "a dog"; ſo they derive their name from following the track. See the article *BLOOD-Hound*.

SLESWICK, an ancient and conſiderable town of Denmark, and capital of a duchy of the ſame name in the province of Gottorp, with a biſhop's ſee, ſecularized in 1586. Cloſe to it is the old palace of Gottorp, formerly the ducal reſidence, but at preſent inhabited by the ſtadtholder or governor. This town was once much more conſiderable than it is at preſent, having ſuffered greatly by the wars of Germany. It is ſeated on the gulph of Sley, where there is a good harbour, 60 miles north-weſt of Lubeck, and 125 ſouth-weſt of Copenhagen. E. Long. 10. 0. N. Lat. 54. 40.

SLESWICK, the duchy of, *or South Jutland*, is about 100 miles in length and 60 in breadth. It is bounded on the north by North Jutland, on the eaſt by the Baltic Sea, on the ſouth by Holſtein, and on the weſt by the ocean. It contains 14 cities, 17 towns, 13 caſtles, 278 pariſhes, 1480 villages, 162 farms, 116 water-mills, and 106 gentlemens ſeats. It is a pleaſant, fertile, populous country, and a ſovereign duchy. Formerly the king of Denmark had half of it, and the other belonged to the houſe of Holſtein-Gottorp; but the former having conquered this duchy, had the poſſeſſion of it confirmed to him by the treaty of the north in 1720. In 1731, a prince of Bareith Culmbach was made governor of this duchy, who reſides at Gottorp.

Slich || Sligo.

SLICH, in metallurgy, the ore of any metal, particularly of gold, when it has been pounded, and prepared for farther working.

The manner of preparing the ſlich at Chremnitz in Hungary is this; they lay a foundation of wood three yards deep, upon this they place the ore, and over this there are 24 beams, armed at their bottoms with iron; theſe, by a continual motion, beat and grind the ore, till it is reduced to powder: during this operation, the ore is covered with water. There are four wheels uſed to move theſe beams, each wheel moving ſix; and the water, as it runs off, carrying ſome of the metalline particles with it, is received into ſeveral baſons, one placed behind another; and finally, after having paſſed through them all, and depoſited ſome ſediment in each, it is let off into a very large pit, almoſt half an acre in extent; in which it is ſuffered to ſtand ſo long, as to depoſit all its ſediment, of whatever kind, and after this it is let out. This work is carried on day and night, and the ore taken away and replaced by more as often as occaſion requires. That ore which lies next the beams, by which it was pounded, is always the cleaneſt or richeſt.

When the ſlich is waſhed as much as they can, a hundred weight of it uſually contains about an ounce, or perhaps but half an ounce of metal, which is not all gold; for there is always a mixture of gold and ſilver, but the gold is in the largeſt quantity, and uſually is two-thirds of the mixture: they then put the ſlich into a furnace with ſome limeſtone, and ſlacken, or the ſcoria of former meltings, and run them together. The firſt melting produces a ſubſtance called *lech*; this lech they burn with charcoal, to make it lighter, to open its body, and render it porous, after which it is called *roſt*; to this roſt they add ſand in ſuch quantity as they find neceſſary, and then melt it over again.

At Chremnitz they have many other ways of reducing gold out of its ore, but particularly one, in which they employ no lead during the whole operation; whereas, in general, lead is always neceſſary, after the before mentioned proceſſes. See GOLD.

SLIDING RULE, a mathematical inſtrument, ſerving to work queſtions in gauging, meaſuring, &c. without the uſe of compaſſes; merely by the ſliding of the parts of the inſtrument one by another, the lines and diviſions whereof give the anſwer by inſpection.

This inſtrument is variouſly contrived, and applied by various authors, particularly Everard, Coggeſhall, Gunter, Hunt, and Partridge; but the moſt common and uſeful are thoſe of Everard and Coggeſhall.

SLIGO, a county, in the province of Connaught, Ireland, 25 miles in length, and as much in breadth; bounded on the eaſt by that of Leitrim, on the weſt by the county of Mayo, on the north and north weſt by the weſtern ocean, and on the ſouth and ſouth-weſt

Sling || Sloane.

by Roſcommon and Mayo. It contains 5970 houſes, 41 pariſhes, 6 baronies, 1 borough, and ſends 4 members to parliament, two for the county, and two for the borough of the ſame name, which is the only market-town in the county, and is ſeated on a bay of the ſame name, 30 miles weſt of Killalla, and 110 north-eaſt of Dublin. W. Long. 8. 26. N. Lat. 54. 13.

SLING, an inſtrument ſerving for caſting ſtones with great violence. The inhabitants of the Balearic iſlands were famous in antiquity for the dexterous management of the ſling: it is ſaid they uſed three kinds of ſlings, ſome longer, others ſhorter, which they uſed according as their enemies were either nearer or more remote. It is added, that the firſt ſerved them for a head-band, the ſecond for a girdle, and that the third they conſtantly carried in their hand.

SLINGING is uſed variouſly at ſea; but chiefly for hoiſting up caſks or other heavy things with ſlings, *i. e.* contrivances of ropes ſpliced into themſelves at either end, with one eye big enough to receive the caſk or whatever is to be ſlung. There are other ſlings, which are made longer, and with a ſmall eye at each end; one of which is put over the breech of a piece of ordnance, and the other eye comes over the end of an iron crow, which is put into the mouth of the piece, to weigh and hoiſe the gun as they pleaſe. There are alſo ſlings by which the yards are bound faſt to the croſs-tree aloft, and to the head of the maſt, with a ſtrong rope or chain, that if the tie ſhould happen to break, or to be ſhot to pieces in fight, the yard, nevertheleſs, may not fall upon the hatches.

Slinging a Man overboard, in order to ſtop a leak in a ſhip, is done thus: the man is truſſed up about the middle in a piece of canvas, and a rope to keep him from ſinking, with his arms at liberty, a mallet in one hand, and a plug, wrapped in oakum and well tarred in a tarpawling clout, in the other, which he is to beat with all diſpatch into the hole or leak.

SLOANE (Sir Hans), baronet, eminently diſtinguiſhed as a phyſician and a naturaliſt, was of Scotch extraction, his father Alexander Sloane being at the head of that colony of Scots which King James I. ſettled in the north of Ireland, where our author was born, at Killieagh, on the 16th of April 1660. At a very early period, he diſplayed a ſtrong inclination for natural hiſtory; and this propenſity being encouraged by a ſuitable education, he employed thoſe hours which young people generally loſe by purſuing low and trifling amuſements, in the ſtudy of nature, and contemplating her works. When about ſixteen, he was attacked by a ſpitting of blood, which threatened to be attended with conſiderable danger, and which interrupted the regular courſe of his application for three years; he had, however, already learned enough of phyſic to know that a malady of this kind was not to be removed ſuddenly, and he prudently abſtained from wine and other liquors that were likely to increaſe it.

By ſtrictly obſerving this ſevere regimen, which in ſome meaſure he continued ever after, he was enabled to prolong his life beyond the ordinary bounds; being an example of the truth of his own favourite maxim, that ſobriety, temperance, and moderation, are the beſt and moſt powerful preſervatives that nature has granted to mankind.

As ſoon as he recovered from this infirmity, he reſolved to perfect himſelf in the different branches of phyſic, which was the profeſſion he had made choice of; and with this view he repaired to London, where he hoped to receive that aſſiſtance which he could not find in his own country. Sloane.

On his arrival in the metropolis, he entered himſelf as a pupil to the great Stafforth, an excellent chemiſt, bred under the illuſtrious Stahl; and by his inſtructions he gained a perfect knowledge of the compoſition and preparation of the different kinds of medicines then in uſe. At the ſame time, he ſtudied botany at the celebrated garden at Chelſea, aſſiduouſly attended the public lectures of anatomy and phyſic, and in ſhort neglected nothing that he thought likely to prove ſerviceable to him in his future practice. His principal merit, however, was his knowledge of natural hiſtory; and it was this part of his character which introduced him early to the acquaintance of Mr Boyle and Mr Ray, two of the moſt eminent naturaliſts of that age. His intimacy with theſe diſtinguiſhed characters continued as long as they lived; and as he was careful to communicate to them every object of curioſity that attracted his attention, the obſervations which he occaſionally made often excited their admiration and obtained their applauſe.

After ſtudying four years at London with unremitting ſeverity, Mr Sloane determined to viſit foreign countries for farther improvement. In this view he ſet out for France in the company of two other ſtudents, and having croſſed to Dieppe, proceeded to Paris. In the way thither they were elegantly entertained by the famous M. Lemery the elder; and in return Mr Sloane preſented that eminent chemiſt with a ſpecimen of four different kinds of phoſphorus, of which, upon the credit of other writers, M. Lemery had treated in his book of chemiſtry, though he had never ſeen any of them.

At Paris Mr Sloane lived as he had done in London. He attended the hoſpitals, heard the lectures of Tournefort, De Verney, and other eminent maſters; viſited all the literati, who received him with particular marks of eſteem, and employed himſelf wholly in ſtudy.

From Paris Mr Sloane went to Montpelier; and, being furniſhed with letters of recommendation from M. Tournefort to M. Chirac, then chancellor of that univerſity, he found eaſy acceſs, through his means, to all the learned men of the province, particularly to M. Magnol, whom he always accompanied in his botanical excurſions in the environs of that city, where he beheld with pleaſure and admiration the ſpontaneous productions of nature, and learned under his inſtructions to claſs them in a proper manner.

Having here found an ample field for contemplation, which was entirely ſuited to his taſte, he took leave of his two companions, whom a curioſity of a different kind led into Italy.

After ſpending a whole year in collecting plants, he travelled through Languedoc with the ſame deſign; and paſſing through Thouloufe and Bourdeaux, returned to Paris, where he made a ſhort ſtay. About the end of the year 1684 he ſet out for England, with an intention of ſettling there as a phyſician. On his arrival in London, he made it his firſt buſineſs to viſit his two illuſtrious friends Mr Ray and Mr Boyle, in order

to

Sloane. to communicate to them the diſcoveries he had made in his travels. The latter he found at home, but the former had retired to Eſſex; to which place Mr Sloane tranſmitted a great variety of plants and ſeeds, which Mr Ray has deſcribed in his Hiſtory of Plants, and for which he makes a proper acknowledgment.

About the year 1706 our author became acquainted with the celebrated Sydenham; who ſoon contracted ſo warm an affection for him that he took him into his houſe, and recommended him in the ſtrongeſt manner to his patients. He had not been long in London before he was propoſed by Dr Martin Liſter as a candidate to be admitted a member of the Royal Society, on the 26th of November 1684; and being approved, he was elected on the 21ſt of January following.

In 1685 he communicated ſome curioſities to the Society; and in July the ſame year he was a candidate for the office of their aſſiſtant ſecretary, but without ſucceſs, as he was obliged to give way to the ſuperior intereſt of his competitor Dr Halley. On the 12th of April 1687, he was choſen a fellow of the college of phyſicians in London; and the ſame year his friend and fellow traveller Dr Tancred Robinſon, having mentioned to the Society the plant called the *ſtar of the earth*, as a remedy newly diſcovered for the bite of a mad dog, Dr Sloane acquainted them that this virtue of the plant was to be found in a book called *De Grey's Farriery*; and that he knew a man who had cured with it twenty couple of dogs. This obſervation he made on the 13th of July, and on the 12th of September following he embarked at Portſmouth for Jamaica with the duke of Albemarle, who had been appointed governor of that iſland. The doctor attended his grace in quality of phyſician, and arrived at Jamaica on the 19th of December following.

Here a new field was opened for freſh diſcoveries in natural productions; but the world would have been deprived of the fruits of them, had not our author, by incredible application, converted, as we may ſay, his minutes into hours. The duke of Albemarle died ſoon after he landed, and the ducheſs determined to return to England whenever an anſwer ſhould be received to the letter ſhe had ſent to court on that melancholy occaſion. As Dr Sloane could not think of leaving her grace in her diſtreſs, whilſt the reſt of her retinue were preparing for their departure he improved it in making collections of natural curioſities; ſo that though his whole ſtay at Jamaica was not above fifteen months, he brought together ſuch a prodigious number of plants, that on his return to England Mr Ray was aſtoniſhed that one man could procure in one iſland, and in ſo ſhort a ſpace, ſo vaſt a variety.

On his arrival in London he applied himſelf to the practice of his profeſſion; and ſoon became ſo eminent, that he was choſen phyſician to Chriſt's Hoſpital on the 17th of October 1694: and this office he held till the year 1730, when, on account of his great age and infirmities, he found it neceſſary to reſign. It is ſomewhat ſingular, and redounds much to the Doctor's honour, that though he received the emoluments of his office punctually, becauſe he would not lay down a precedent which might hurt his ſucceſſors, yet he conſtantly applied the money to the relief of thoſe who were the greateſt objects of compaſſion in the hoſpital, that it might never be ſaid he enriched himſelf by giving health to the poor. He had been elected ſecretary to the Royal Society on the 30th of November 1693; and upon this occaſion he revived the publication of the Philoſophical Tranſactions, which had been omitted for ſome time. He continued to be the editor of this work till the year 1712; and the volumes which appeared during that period are monuments of his induſtry and ingenuity, many of the pieces contained in them being written by himſelf. Sloane.

In the mean time he publiſhed *Catalogus Plantarum quæ in Inſula Jamaica ſponte proveniunt*, &c. *Seu Prodromi Hiſtoriæ Naturalis pars prima*, which he dedicated to the Royal Society and College of Phyſicians. About the ſame time he formed the plan of a diſpenſary, where the poor might be furniſhed at prime coſt with ſuch medicines as their ſeveral maladies might require; which he afterwards carried into execution, with the aſſiſtance of the preſident and other members of the college of phyſicians.

Our author's thirſt for natural knowledge ſeems to have been born with him, ſo that his cabinet of curioſities may be ſaid to have commenced with his being. He was continually enriching and enlarging it; and the fame which, in the courſe of a few years, it had acquired, brought every thing that was curious in art or nature to be firſt offered to him for purchaſe. Theſe acquiſitions, however, increaſed it but very ſlowly in compariſon of the augmentation it received in 1701 by the death of William Courten, Eſq; a gentleman who had employed all his time, and the greater part of his fortune, in collecting rarities, and who bequeathed the whole to Dr Sloane, on condition of his paying certain debts and legacies with which he had charged it. Theſe terms our author accepted, and he executed the will of the donor with the moſt ſcrupulous exactneſs; on which account ſome people have ſaid, that he purchaſed Mr Courten's curioſities at a dear rate.

In 1707 the firſt volume of Dr Sloane's Natural Hiſtory of Jamaica appeared in folio, though the publication of the ſecond was delayed till 1725. By this very uſeful as well as magnificent work the materia medica was enriched with a great number of excellent drugs not before known. In 1708 the Doctor was elected a foreign member of the Royal Academy of Sciences at Paris, in the room of Mr Tſchirnaus; an honour ſo much the greater, as we were then at war with France, and the queen's expreſs conſent was neceſſary before he could accept it. In proportion as his credit roſe among the learned, his practice increaſed among the people of rank: Queen Anne herſelf frequently conſulted him, and in her laſt illneſs was blooded by him.

On the advancement of George I. to the throne, that prince, on the 3d of April 1716, created the Doctor a baronet, an hereditary title of honour to which no Engliſh phyſician had before attained; and at the ſame time made him phyſician general to the army, in which ſtation he continued till 1727, when he was appointed phyſician in ordinary to George II. He attended the royal family till his death; and was particularly favoured by Queen Caroline, who placed the greateſt confidence in his preſcriptions. In the mean time he had been unanimouſly choſen one of the elects of the college of phyſicians June 1. 1716, and he was elected preſident of the ſame body on September 30. 1719, an office which he held for ſixteen years. Du-

Sloane.

ring that period he not only gave the higheſt proofs of his zeal and aſſiduity in the diſcharge of his duty, but in 1721 made a preſent to that ſociety of L. 100; and ſo far remitted a very conſiderable debt, which the corporation owed him, as to accept it in ſuch ſmall ſums as were leaſt inconvenient to the ſtate of their affairs. Sir Hans was no leſs liberal to other learned bodies. He had no ſooner purchaſed the manor of Chelſea, than he gave the company of apothecaries the entire freehold of their botanical garden there, upon condition only that they ſhould preſent yearly to the Royal Society fifty new plants, till the number ſhould amount to 2000 (A). He gave beſides ſeveral other conſiderable donations for the improvement of this garden; the ſituation of which, on the banks of the Thames, and in the neighbourhood of the capital, was ſuch as to render it uſeful in two reſpects: Firſt, by producing the moſt rare medicinal plants; and, ſecondly, by ſerving as an excellent ſchool for young botaniſts; an advantage which he himſelf had derived from it in the early part of his life.

The death of Sir Iſaac Newton, which happened in 1727, made way for the advancement of Sir Hans to the preſidency of the Royal Society. He had been vice-preſident, and frequently ſat in the chair for that great man; and by his long connection with this learned body he had contracted ſo ſtrong an affection for it, that he made them a preſent of an hundred guineas, cauſed a curious buſt of King Charles II. its founder, to be erected in the great hall where it met, and, as is ſaid, was very inſtrumental in procuring Sir Godfrey Copley's benefaction of a medal of the value of five guineas, to be annually given as an honorary mark of diſtinction to the perſon who communicates the beſt experiments to the Society.

On his being raiſed to the chair, Sir Hans laid aſide all thoughts of further promotion, and applied himſelf wholly to the faithful diſcharge of the duties of the offices which he enjoyed. In this laudable occupation he employed his time from 1727 to 1740, when, at the age of fourſcore, he formed a reſolution of quitting the ſervice of the public, and of living for himſelf. With this view he reſigned the preſidency of the Royal Society much againſt the inclination of that reſpectable body, who choſe Martin Folkes, Eſq; to ſucceed him, and in a public aſſembly thanked him for the great and eminent ſervices he had rendered them. In the month of January 1741, he began to remove his library, and his cabinet of rarities, from his houſe in Bloomſbury to that at Chelſea; and on the 12th of March following, having ſettled all his affairs, he retired thither himſelf, to enjoy in peaceful tranquillity the remains of a well-ſpent life. He did not, however, bury himſelf in that ſolitude which excludes men from ſociety. He received at Chelſea, as he had done in London, the viſits of people of diſtinction, of all learned foreigners, and of the royal family, who ſometimes did him the honour to wait on him; but, what was ſtill more to his praiſe, he never refuſed admittance or advice to rich or poor who came to conſult him concerning their health. Not contented with this contracted method of doing good, he now, during his retreat, preſented to the public ſuch uſeful remedies as ſucceſs had warranted, during the courſe of a long continued practice. Among theſe is the efficacious receipt for diſtempers in the eyes, and his remedy for the bite of a mad dog.

Sloane, Sloanes.

During the whole courſe of his life, Sir Hans had lived with ſo much temperance, as had preſerved him from feeling the infirmities of old age; but in his 90th year he began to complain of pains, and to be ſenſible of an univerſal decay. He was often heard to ſay, that the approach of death brought no terrors along with it; that he had long expected the ſtroke; and that he was prepared to receive it whenever the great Author of his being ſhould think fit. After a ſhort illneſs of three days, he died on the 11th of January 1752, and was interred on the 18th at Chelſea, in the ſame vault with his lady, the ſolemnity being attended with the greateſt concourſe of people, of all ranks and conditions, that had ever been ſeen before on the like occaſion.

Sir Hans being extremely ſolicitous leſt his cabinet of curioſities, which he had taken ſo much pains to collect, ſhould be again diſſipated at his death, and being at the ſame time unwilling that ſo large a portion of his fortune ſhould be loſt to his children, he bequeathed it to the public, on condition that L. 20,000 ſhould be made good by parliament to his family. This ſum, though large in appearance, was ſcarcely more than the intrinſic value of the gold and ſilver medals, the ores and precious ſtones that were found in it; for in his laſt will he declares, that the firſt coſt of the whole amounted at leaſt to L. 50,000. Beſides his library, conſiſting of more than 50,000 volumes, 347 of which were illuſtrated with cuts finely engraven and coloured from nature, there were 3560 manuſcripts, and an infinite number of rare and curious works of every kind. The parliament accepted the legacy, and fulfilled the conditions.

SLOANEA, in botany: A genus of plants belonging to the claſs of *polyandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 50th order, *Amentaceæ*. The corolla is pentapetalous; the calyx pentaphyllous and deciduous; the ſtigma is perforated;

(A) This garden was firſt eſtabliſhed by the company in 1673; and having after that period been ſtocked by them with a great variety of plants, for the improvement of botany, Sir Hans, in order to encourage ſo ſerviceable an undertaking, granted to the company the inheritance of it, being part of his eſtate and manor of Chelſea, on condition that it ſhould be for ever preſerved as a phyſic garden. As a proof of its being ſo maintained, he obliged the company, in conſideration of the ſaid grant, to preſent yearly to the Royal Society, in one of their weekly meetings, fifty ſpecimens of plants that had grown in the garden the preceding year, and which were all to be ſpecifically diſtinct from each other, until the number of two thouſand ſhould be completed. This number was completed in the year 1761. In 1733 the company erected a marble ſtatue of Sir Hans, executed by Ryſbrac, which is placed upon a pedeſtal in the centre of the garden, with a Latin inſcription, expreſſing his donation, and the deſign and advantages of it.

Sloe || Sluice.

perforated; the berry is corticoſe, echinated, polyſpermous, and gaping. There are two ſpecies, the *dentata* and *emarginata*.

SLOE. See PRUNUS.

SLOOP, a ſmall veſſel furniſhed with one maſt, the mainſail of which is attached to a gaff above, or to the maſt on its foremoſt edge, and to a long boom below, by which it is occaſionally ſhifted to either quarter. See SHIP.

SLOOP of War, a name given to the ſmalleſt veſſels of war except cutters. They are either rigged as ſhips or ſnows.

SLOT, in the ſportſman's language, a term uſed to expreſs the mark of the foot of a ſtag or other animal proper for the chace in the clay or earth, by which they are able to gueſs when the animal paſſed, and which way he went. The ſlot, or treading of the ſtag, is very nicely ſtudied on this occaſion; if the ſlot be large, deep printed in the ground, and with an open cleft, and, added to theſe marks, there is a large ſpace between mark and mark, it is certain that the ſtag is an old one. If there be obſerved the ſlots or treadings of two, the one long and the other round, and both of one ſize, the long ſlot is always that of the larger animal. There is alſo another way of knowing the old ones from the young ones by the treading; which is, that the hinder feet of the old ones never reach to their fore feet, whereas thoſe of the young ones do.

SLOTH, in zoology. See BRADYPUS.

SLOUGH, a deep muddy place. The caſt ſkin of a ſnake, the damp of a coal pit, and the ſcar of a wound, are alſo called by the ſame appellation. The *ſlough* of a wild boar is the bed, ſoil, or mire, wherein he wallows, or in which he lies in the day-time.

SLUCZK, a large and populous town in Poland, in Lithuania, and capital of a duchy of the ſame name; famous for three battles gained here by Conſtantine duke of Oſtrog over the Tartars, in the reign of Sigiſmund I. It is ſeated on the river Sluczk, 72 miles ſouth-eaſt of Minſki, and 70 ſouth of Novogrodeck. E. Long. 27. 44. N. Lat. 53. 2.

SLUG, in zoology. See LIMAX.

SLUICE, a frame of timber, ſtone, or other matter, ſerving to retain and raiſe the water of a river, &c. and on occaſion to let it paſs.

Such is the ſluice of a mill, which ſtops and collects the water of a rivulet, &c. to let it fall at length in the greater plenty upon the mill-wheel: ſuch alſo are thoſe uſed as vents or drains to diſcharge water off land. And ſuch are the ſluices of Flanders, &c. which ſerve to prevent the waters of the ſea from overflowing the lower lands.

Sometimes there is a kind of canal incloſed between two gates or ſluices, in artificial navigations, to ſave the water, and render the paſſage of boats equally eaſy and ſafe, upwards and downwards; as in the ſluices of Briare in France, which are a kind of maſſive walls built parallel to each other, at the diſtance of 20 or 24 feet, cloſed with ſtrong gates at each end, between which is a kind of canal or chamber, conſiderably longer than broad; wherein a veſſel being incloſed, the water is let out at the firſt gate, by which the veſſel is raiſed 15 or 16 feet, and paſſed out of this canal into another much higher. By ſuch means a boat is conveyed out of the Loire into the Seine, though the ground between them riſe above 150 feet higher than either of thoſe rivers ‡.

Sluice || Smalt.

‡ See Canal.

Sluices are made different ways, according to the uſe for which they are intended: when they ſerve for navigation, they are ſhut with two gates, preſenting an angle towards the ſtream; when they are made near the ſea, two pair of gates are made, the one to keep the water out and the other in, as occaſion requires: in this caſe, the gates towards the ſea preſent an angle that way, and the others the contrary way; and the ſpace incloſed by thoſe gates is called the *chamber*. When ſluices are made in the ditches of a fortreſs, to keep up the water in ſome parts, inſtead of gates, ſhutters are made ſo as to ſlide up and down in grooves; and when they are made to raiſe an inundation, they are then ſhut by means of ſquare timbers let down in culliſes, ſo as to lie cloſe and firm,

The word *ſluice* is formed of the French *eſcluſe*, which Menage derives from the Latin *excluſa*, found in the Salic law in the ſame ſenſe. But this is to be reſtrained to the ſluices of mills, &c. for as to thoſe ſerving to raiſe veſſels, they were wholly unknown to the ancients.

SLUR, in muſic, a mark like the arch of a circle, drawn from one note to another, comprehending two or more notes in the ſame or different degrees. If the notes are in different degrees, it ſignifies that they are all to be ſung to one ſyllable; for wind inſtruments, that they are to be made in one continued breath; and for ſtringed inſtruments that are ſtruck with a bow, as a violin, &c. that they are made with one ſtroke. If the notes are in the ſame degree, it ſignifies that it is all one note, to be made as long as the whole notes ſo connected; and this happens moſt frequently betwixt the laſt note of one line and the firſt of the next; which is particularly called *ſyncopation*.

SLUYS, a town of Dutch Flanders, oppoſite the iſland of Cadſand, with a good harbour, 10 miles north of Bruges. E. Long. 3. 25. N. Lat. 51. 19.

SMACK, a ſmall veſſel, commonly rigged as a ſloop or hoy, uſed in the coaſting or fiſhing trade, or as a tender in the king's ſervice.

SMALAND, or EAST GOTHLAND, a province of Sweden, which makes part of Gothland; and is bounded on the north by Oſtrogothia or Eaſt Gothland, on the eaſt by the Baltic Sea, on the ſouth by Schonen and Bleckingia, and on the weſt by Weſtrogothia or Weſt Gothland. It is about 112 miles in length, and 62 in breadth. Calmar is the capital town.

SMALKALD, a town of Germany, in Franconia, and in the county of Henneberg: famous for the confederacy entered into by the German Proteſtants againſt the emperor, commonly called the *league of Smalkald*. The deſign of it was to defend their religion and liberties. It is ſeated on the river Werra, 25 miles ſouth-weſt of Erford, and 50 north-weſt of Bamberg. E. Long. 10. 53. N. Lat. 50. 49. It is ſubject to the prince of Heſſe-Caſſel.

SMALLAGE, in botany. See APIUM.

SMALT, a kind of glaſs of a dark blue colour, which when levigated appears of a moſt beautiful colour; and if it could be made ſufficiently fine, would be an excellent ſuccedaneum for ultramarine, as not only reſiſting all kinds of weather, but even the moſt violent fires. It is prepared by melting one part of calcined cobalt with two of flint powder, and one of pot-aſh.

Smaragdus, Smeaton.

At the bottoms of the crucibles in which the ſmalt is manufactured we generally find a regulus of a whitiſh colour inclining to red, and extremely brittle. This is melted afreſh, and when cold ſeparates into two parts; that at the bottom is the cobaltic regulus, which is employed to make more of the ſmalt; the other is biſmuth.

SMARAGDUS, in natural hiſtory. See EMERALD.

SMEATON (John), an eminent civil engineer, was born the 28th of May 1724, O. S. at Auſthorpe, near Leeds, in a houſe built by his grandfather, and where his family have reſided ever ſince.

The ſtrength of his underſtanding and the originality of his genius appeared at an early age; his playthings were not the playthings of children, but the tools which men employ; and he appeared to have greater entertainment in ſeeing the men in the neighbourhood work, and aſking them queſtions, than in any thing elſe. One day he was ſeen (to the diſtreſs of his family) on the top of his father's barn, fixing up ſomething like a windmill; another time, he attended ſome men fixing a pump at a neighbouring village, and obſerving them cut off a piece of bored pipe, he was ſo lucky as to procure it, and he actually made with it a working pump that raiſed water. Theſe anecdotes refer to circumſtances that happened while he was in petticoats, and moſt likely before he attained his ſixth year.

About his 14th and 15th year, he had made for himſelf an engine for turning, and made ſeveral preſents to his friends of boxes in ivory or wood very neatly turned. He forged his iron and ſteel, and melted his metal; he had tools of every ſort for working in wood, ivory, and metals. He had made a lathe, by which he had cut a perpetual ſcrew in braſs, a thing little known at that day, which was the invention of Mr Henry Hindley of York; with whom Mr Smeaton ſoon became acquainted, and they ſpent many a night at Mr Hindley's houſe till day-light, converſing on thoſe ſubjects.

Thus had Mr Smeaton, by the ſtrength of his genius and indefatigable induſtry, acquired, at the age of 18, an extenſive ſet of tools, and the art of working in moſt of the mechanical trades, without the aſſiſtance of any maſter. A part of every day was generally occupied in forming ſome ingenious piece of mechaniſm.

Mr Smeaton's father was an attorney, and deſirous of bringing him up to the ſame profeſſion, Mr Smeaton therefore came up to London in 1742, and attended the courts in Weſtminſter hall; but finding (as his common expreſſion was) that the law did not ſuit the bent of his genius, he wrote a ſtrong memorial to his father on that ſubject; whoſe good ſenſe from that moment left Mr Smeaton to purſue the bent of his genius in his own way.

In 1751 he began a courſe of experiments to try a machine of his invention to meaſure a ſhip's way at ſea, and alſo made two voyages in company with Dr Knight to try it, and a compaſs of his own invention and making, which was made magnetical by Dr Knight's artificial magnets: the ſecond voyage was made in the Fortune ſloop of war, commanded at that time by Captain Alexander Campbell.

In 1753 he was elected member of the Royal Society; the number of papers publiſhed in their Tranſactions will ſhow the univerſality of his genius and knowledge. In 1759 he was honoured by an unanimous vote with their gold medal for his paper intitled "An Experimental Inquiry concerning the Natural Powers of Water and Wind to turn Mills, and other Machines depending on a Circular Motion." Smeaton.

This paper, he ſays, was the reſult of experiments made on working models in the years 1752 and 1753, but not communicated to the Society till 1759; before which time he had an opportunity of putting the effect of theſe experiments into real practice, in a variety of caſes, and for various purpoſes, ſo as to aſſure the Society he had found them to anſwer.

In December 1755, the Eddyſtone lighthouſe was burnt down: Mr Weſton, the chief proprietor, and the others, being deſirous of rebuilding it in the moſt ſubſtantial manner, inquired of the earl of Macclesfield (then preſident of the Royal Society) whom he thought the moſt proper to rebuild it; his Lordſhip recommended Mr Smeaton.

Mr Smeaton undertook the work, and completed it in the ſummer of 1759. Of this Mr Smeaton gives an ample deſcription in the volume he publiſhed in 1791: that edition has been ſold ſome time ago, and a ſecond is now in the preſs, under the reviſal of his much eſteemed friend Mr Aubert, F. R. S. and governor of the London aſſurance corporation.

Though Mr Smeaton completed the building of the Eddyſtone lighthouſe in 1759 (a work that does him ſo much credit), yet it appears he did not ſoon get into full buſineſs as a civil engineer; for in 1764, while in Yorkſhire, he offered himſelf a candidate for one of the receivers of the Derwentwater eſtate; and on the 31ſt of December in that year, he was appointed at a full board of Greenwich hoſpital, in a manner highly flattering to himſelf; when two other perſons ſtrongly recommended and powerfully ſupported were candidates for the employment. In this appointment he was very happy, by the aſſiſtance and abilities of his partner Mr Walton one of the receivers, who taking upon himſelf the management and accounts, left Mr Smeaton leiſure and opportunity to exert his abilities on public works, as well as to make many improvements in the mills and in the eſtates of Greenwich hoſpital. By the year 1775 he had ſo much buſineſs as a civil engineer, that he wiſhed to reſign this appointment; and would have done it then, had not his friends the late Mr Stuart the hoſpital ſurveyor, and Mr Ibbetſon their ſecretary, prevailed upon him to continue in the office about two years longer.

Mr Smeaton having now got into full buſineſs as a civil engineer, performed many works of general utility. He made the river Calder navigable; a work that required great ſkill and judgment, owing to the very impetuous floods in that river: He planned and attended the execution of the great canal in Scotland for conveying the trade of the country either to the Atlantic or German ocean; and having brought it to the place originally intended, he declined a handſome yearly ſalary, in order that he might attend to the multiplicity of his other buſineſs.

On the opening of the great arch at London bridge, the excavation around and under the ſterlings was ſo conſiderable, that the bridge was thought to be in great

Smeaton. great danger of falling. He was then in Yorkſhire, and was ſent for by expreſs, and arrived with the utmoſt diſpatch: "I think (ſays Mr Holmes, the author of his life) it was on a Saturday morning, when the apprehenſion of the bridge was ſo general that few would paſs over or under it. He applied himſelf immediately to examine it, and to ſound about the ſterlings as minutely as he could; and the committee being called together, adopted his advice, which was to repurchaſe the ſtones that had been taken from the middle pier, then lying in Moorfields, and to throw them into the river to guard the ſterlings." Nothing ſhows the apprehenſions concerning the falling of the bridge more than the alacrity with which this advice was purſued; the ſtones were repurchaſed that day, horſes, carts, and barges, were got ready, and they began the work on Sunday morning. Thus Mr Smeaton, in all human probability, ſaved London-bridge from falling, and ſecured it till more effectual methods could be taken.

The vaſt variety of mills which Mr Smeaton conſtructed, ſo greatly to the ſatisfaction and advantage of the owners, will ſhow the great uſe which he made of his experiments in 1752 and 1753; for he never truſted to theory in any caſe where he could have an opportunity to inveſtigate it by experiment. He built a ſteam engine at Auſthorpe, and made experiments thereon, purpoſely to aſcertain the power of Newcomen's ſteam-engine, which he improved and brought to a far greater degree of perfection, both in its conſtruction and powers, than it was before.

Mr Smeaton during many years of his life was a frequent attendant on parliament, his opinion being continually called for; and here his ſtrength of judgment and perſpicuity of expreſſion had its full diſplay: it was his conſtant cuſtom, when applied to, to plan or ſupport any meaſure, to make himſelf fully acquainted with it, to ſee its merits before he would engage in it: by this caution, added to the clearneſs of his deſcription and the integrity of his heart, he ſeldom failed to obtain for the bill which he ſupported an act of parliament. No one was heard with more attention, nor had any one ever more confidence placed in his teſtimony. In the courts of law he had ſeveral compliments paid him from the bench by Lord Mansfield and others, for the new light which he threw on difficult ſubjects.

About the year 1785 Mr Smeaton's health began to decline; and he then took the reſolution to endeavour to avoid all the buſineſs he could, ſo that he might have leiſure to publiſh an account of his inventions and works, which was certainly the firſt wiſh of his heart; for he has often been heard to ſay, that "he thought he could not render ſo much ſervice to his country as by doing that." He got only his account of the Eddyſtone lighthouſe completed, and ſome preparations to his intended Treatiſe on Mills; for he could not reſiſt the ſolicitations of his friends in various works: and Mr Aubert, whom he greatly loved and reſpected, being choſen chairman of Ramſgate harbour, prevailed upon him to accept the place of engineer to that harbour; and to their joint efforts the public is chiefly indebted for the improvements that have been made there within theſe few years, which fully appears in a report that Mr Smeaton gave in to the board of truſtees in 1791, which they immediately publiſhed.

Mr Smeaton being at Auſthorpe, walking in his garden on the 16th of September 1792, was ſtruck with the palſy, and died the 28th of October. "In his illneſs (ſays Mr Holmes) I had ſeveral letters from him, ſigned with his name, but written and ſigned by another's pen; the diction of them ſhowed the ſtrength of his mind had not left him. In one written the 26th of September, after minutely deſcribing his health and feelings, he ſays, 'in conſequence of the foregoing, I conclude myſelf nine-tenths dead; and the greateſt favour the Almighty can do me (as I think), will be to complete the other part; but as it is likely to be a lingering illneſs, it is only in His power to ſay when that is likely to happen."

Smeaton || Smelling.

Mr Smeaton had a warmth of expreſſion that might appear to thoſe who did not know him well to border on harſhneſs; but thoſe more intimately acquainted with him, knew it aroſe from the intenſe application of his mind, which was always in the purſuit of truth, or engaged in inveſtigating difficult ſubjects. He would ſometimes break out haſtily, when any thing was ſaid that did not tally with his ideas; and he would not give up any thing he argued for, till his mind was convinced by ſound reaſoning.

In all the ſocial duties of life he was exemplary; he was a moſt affectionate huſband, a good father, a warm, zealous, and ſincere friend, always ready to aſſiſt thoſe he reſpected, and often before it was pointed out to him in what way he could ſerve them. He was a lover and encourager of merit wherever he found it; and many men are in a great meaſure indebted to his aſſiſtance and advice for their preſent ſituation. As a companion, he was always entertaining and inſtructive; and none could ſpend any time in his company without improvement.

SMELL, ODOUR, with regard to the organ, is an impreſſion made on the noſe by little particles continually exhaling from odorous bodies: With regard to the object, it is the figure and diſpoſition of odorous effluvia, which, ſticking on the organ, excite the ſenſe of ſmelling: And with regard to the ſoul, it is the perception of the impreſſion of the object on the organ, or the affection in the ſoul reſulting therefrom. See ANATOMY, n° 140; and METAPHYSICS.

SMELLING, the act whereby we perceive ſmells, or whereby we become ſenſible of odorous bodies, by means of certain effluvia thereof; which, ſtriking on the olfactory organ, briſkly enough to have their impulſe propagated to the brain, excite a ſenſation in the ſoul. The principal organs of ſmelling are the noſtrils and the olfactory nerves; the minute ramifications of which latter are diſtributed throughout the whole concave of the former. For their deſcriptions, ſee ANATOMY.

Smelling is performed by drawing into the noſtrils the odorous effluvia floating in the air in inſpiration, which ſtrike with ſuch force againſt the fibrillæ of the olfactory nerves, which the figure of the noſe, and the ſituation of the little bones, render oppoſite thereto, as to ſhake them, and give them a vibratory motion; which action, being communicated hence to the common ſenſory, occaſions an idea of a ſweet, or fetid, or ſour, or an aromatic, or a putrefied object, &c. The matter in animals, vegetables, foſſils, &c. which chiefly affects the ſenſe of ſmelling, Boerhaave obſerves, is that ſubtile ſubſtance, inherent in their oily parts,

Smelling || Smelting.

called *ſpirits*: becauſe, when this is taken away from the moſt fragrant bodies, what remains has ſcarce any ſmell at all; but this, poured on the moſt inodorous bodies, gives them a fragrancy.

Willis obſerves, that brutes have generally the ſenſe of ſmelling in much greater perfection than man: by this alone they diſtinguiſh the qualities of bodies, which could not otherwiſe be known; hunt out their food at a great diſtance, as hounds and birds of prey; or hid among other ſubſtances, as ducks, &c. Man, having other means of judging of his food, &c. did not need ſo much ſagacity in his noſe; yet have we inſtances of a great deal even in man. In the *Hiſtoire des Antilles*, we are aſſured there are negroes who, by the ſmell alone, can diſtinguiſh between the footſteps of a Frenchman and a negro. It is found, that the laminæ, wherewith the upper part of the noſtrils is fenced, and which ſerve to receive the divarications of the olfactory nerves, are always longer, and folded up together in greater numbers, as the animal has this ſenſe more acute: the various windings and turnings of theſe laminæ detaining the odoriferous particles.

The ſenſe of ſmelling may be diminiſhed or deſtroyed by diſeaſes; as by the moiſture, dryneſs, inflammation, or ſuppuration of the olfactory membrane, the compreſſion of the nerves which ſupply it, or ſome fault in the brain itſelf at their origin. A defect, or too great a degree of ſolidity of the ſmall ſpongy bones of the upper jaw, the caverns of the forehead, &c. may likewiſe impair this ſenſe; and it may be alſo injured by a collection of fetid matter in theſe caverns, which is continually exhaling from them, and alſo by immoderate uſe of ſnuff. When the noſe abounds with moiſture, after gentle evacuations, ſuch things as tend to take off irritation and coagulate the thin ſharp ſerum may be applied; as the oil of aniſe mixed with fine flour, camphor diſſolved in oil of almonds, &c. the vapours of amber, frankincenſe, gum-maſtic, and benjamin, may likewiſe be received into the noſe and mouth. For moiſtening the mucus when it is too dry, ſome recommend ſnuff made of the leaves of marjoram, mixed with oil of amber, marjoram, and aniſeed; or a ſternutatory of calcined white vitriol, twelve grains of which may be mixed with two ounces of marjoram water and filtrated. The ſteam of vinegar upon hot iron, and received up the noſtrils, is alſo of uſe for ſoftening the mucus, removing obſtructions, &c. If there be an ulcer in the noſe, it ought to be dreſſed with ſome emollient ointment, to which, if the pain be very great, a little laudanum may be added. If it be a venereal ulcer, 12 grains of corroſive ſublimate may be diſſolved in a pint and a half of brandy, a table ſpoonful of which may be taken twice a day. The ulcer ought likewiſe to be waſhed with it, and the fumes of cinnabar may be received up the noſtrils.

If there be reaſon to ſuſpect that the nerves which ſupply the organs of ſmelling are inert, or want ſtimulating, volatile ſalts, or ſtrong ſnuffs, and other things which occaſion ſneezing, may be applied to the noſe; the forehead may likewiſe be anointed with balſam of Peru, to which may be added a little oil of amber.

SMELT, in ichthyology. See SALMO.

SMELTING, in metallurgy, the fuſion or melting of the ores of metals, in order to ſeparate the metalline part from the earthy, ſtony, and other parts. See METALLURGY, Part III.

Smew, Smilax.

SMEW, in ornithology. See MERGUS.

SMILAX, ROUGH BINDWEED, in botany: A genus of plants belonging to the claſs of *diœcia* and order of *hexandria*; and in the natural ſyſtem ranging under the 11th order, *Sarmentaceæ*. The male calyx is hexaphyllous, and there is no corolla; the female calyx is alſo hexaphyllous, without any corolla: there are three ſtyles, a trilocular berry, and two ſeeds. There are 18 ſpecies; the aſpera, excelſa, zeilanica, ſarſaparilla, china, rotundifolia, laurifolia, tamnoides, caduca, bona nox, herbacea, tetragona, lanceolata, and pſeudo-china. Of theſe, the ſmilax ſarſaparilla, which affords the ſarſaparilla root, is the moſt valuable. This is well deſcribed in the London Medical Journal by Dr Wright, who, during a long reſidence in Jamaica, made botany his peculiar ſtudy.

"This ſpecies (ſays he) has ſtems of the thickneſs of a man's finger: they are jointed, triangular, and beſet with crooked ſpines. The leaves are alternate, ſmooth and ſhining on the upper ſide; on the other ſide are three nerves or coſtæ, with ſundry ſmall crooked ſpines. The flower is yellow, mixed with red. The fruit is a black berry, containing ſeveral brown ſeeds.

"Sarſaparilla delights in low moiſt grounds and near the banks of rivers. The roots run ſuperficially under the ſurface of the ground. The gatherers have only to looſen the ſoil a little, and to draw out the long fibres with a wooden hook. In this manner they proceed till the whole root is got out. It is then cleared of the mud, dried, and made into bundles.

"The ſenſible qualities of ſarſaparilla are mucilaginous and farinaceous, with a ſlight degree of acrimony. The latter, however, is ſo ſlight as not to be perceived by many; and I am apt to believe that its medicinal powers may fairly be aſcribed to its demulcent and farinaceous qualities.

"Since the publication of Sir William Fordyce's paper on Sarſaparilla in the Medical Obſervations and Inquiries, Vol. I. ſarſaparilla has been in more general uſe than formerly. The planters in Jamaica ſupply their eſtates with great quantities of it; and its exhibition has been attended with very happy conſequences in the yawsand in venereal affections; as nodes, tophi, and exoſtoſis; pains of the bones, and carious or cancerous ulcers.

"Sir William Fordyce ſeems to think ſarſaparilla a ſpecific in all ſtages of lues; but from an attentive and careful obſervation of its effects in ſome thouſands of caſes, I muſt declare I could place no dependence on ſarſaparilla alone. But if mercury had formerly been tried, or was uſed along with ſarſaparilla, a cure was ſoon effected. Where the patients had been reduced by pain, diſorder, and mercury, I preſcribed a decoction of ſarſaparilla, and a table-ſpoonful of the powder of the ſame, twice a day, with the greateſt ſucceſs, in the moſt deplorable caſes of lues, ill-cured yaws, and carious or ill-diſpoſed ſores or cancers."

The china, or oriental ſpecies of china root, has roundiſh prickly ſtalks and red berries, and is a native of China and Japan. The pſeudo-china, or occidental ſpecies, has rounder ſmooth ſtalks and black berries, grows wild in Jamaica and Virginia, and bears the colds of our own climate.

Theſe

Smilax, Smith.

Lewis's Materia Medica.

These roots have scarce any smell or particular taste: when fresh, they are said to be somewhat acrid, but as brought to us they discover, even when long chewed, no other than a slight unctuosity in the mouth. Boiled in water, they impart a reddish colour, and a kind of vapid softness: the decoction when inspissated yields an unctuous, farinaceous, almost insipid mass, amounting to upwards of half the weight of the root. They give a gold yellow tincture to rectified spirit, but make no sensible alteration in its taste: on drawing off the spirit from the filtered liquor, there remains an orange-coloured extract, nearly as insipid as that obtained by water, but scarcely in half its quantity.

China root is generally supposed to promote perspiration and urine, and by its soft unctuous quality to blunt acrimonious humours. It was first introduced into Europe about the year 1535, with the character of a specific against venereal disorders: the patient was kept warm, a weak decoction of china root was used for common drink, and a stronger decoction taken twice a day in bed to promote a sweat. Such a regimen is doubtless a good auxiliary to mercurial alteratives: but whatever may be its effects in the warmer climates, it is found in this to be of itself greatly insufficient. At present the china root is very rarely made use of, having for some time given place to sarsaparilla, which is supposed to be more effectual. Prosper Alpinus informs us, that this root is in great esteem among the Egyptian women for procuring fatness and plumpness.

SMITH (Sir Thomas), was born at Walden in Essex in 1512. At 14 he was sent to Queen's college Cambridge, where he distinguished himself so much, that he was made Henry VIII.'s scholar together with John Cheke. He was chosen a fellow of his college in 1531, and appointed two years after to read the public Greek lecture. The common mode of reading Greek at that time was very faulty; the same sound being given to the letters and diphthongs ι, η, υ, ει, οι, υι. Mr Smith and Mr Cheke had been for some time sensible that this pronunciation was wrong: and after a good deal of consultation and research, they agreed to introduce that mode of reading which prevails at present. Mr Smith was lecturing on *Aristotle de Republica* in Greek. At first he dropped a word or two at intervals in the new pronunciation, and sometimes he would stop as if he had committed a mistake and correct himself. No notice was taken of this for two or three days; but as he repeated more frequently, his audience began to wonder at the unusual sounds, and at last some of his friends mentioned to him what they had remarked. He owned that something was in agitation, but that it was not yet sufficiently digested to be made public. They entreated him earnestly to discover his project: he did so; and in a short time great numbers resorted to him for information. The new pronunciation was adopted with enthusiasm, and soon became universal at Cambridge. It was afterwards opposed by bishop Gardiner the chancellor; but its superiority to the old mode was so visible, that in a few years it spread over all England.

In 1539 he travelled into foreign countries, and studied for some time in the universities of France and Italy. On his return he was made regius professor of civil law at Cambridge. About this time he published a treatise on the mode of pronouncing English. He was useful likewise in promoting the reformation. Having gone into the family of the duke of Somerset, the protector during the minority of Edward VI. he was employed by that nobleman in public affairs; and in 1548 was made secretary of state, and received the honour of knighthood. While that nobleman continued in office, he was sent ambassador, first to Brussels and afterwards to France. Smith.

Upon Mary's accession he lost all his places, but was fortunate enough to preserve the friendship of Gardiner and Bonner. He was exempted from persecution, and was allowed, probably by their influence, a pension of L. 100. During Elizabeth's reign he was employed in public affairs, and was sent three times by that princess as her ambassador to France. He died in 1577. His abilities were excellent, and his attainments uncommonly great: He was a philosopher, a physician, a chemist, mathematician, linguist, historian, and architect. He wrote, 1. A treatise called the *English Commonwealth*. 2. A letter *De Recta et Emendata Linguæ Græcæ Pronunciatione*. 3. *De Moribus Turcarum*. 4. *De Druidum Moribus*.

SMITH (Edmund), a distinguished English poet, the only son of Mr Neale an eminent merchant, by a daughter of baron Lechmere, was born in 1668. By his father's death he was left young to the care of Mr Smith, who had married his father's sister, and who treated him with so much tenderness, that at the death of his generous guardian he assumed his name. His writings are not many, and those are scattered about in miscellanies and collections: his celebrated tragedy of Phædra and Hippolitus was acted in 1707; and being introduced at a time when the Italian opera so much engrossed the polite world, gave Mr Addison, who wrote the prologue, an opportunity to rally the vitiated taste of the public. However, notwithstanding the esteem it has always been held in, it is perhaps rather to be considered as a fine poem than as a good play. This tragedy, with a Poem to the memory of Mr John Philips, three or four Odes, with a Latin oration spoken at Oxford *in laudem Thomæ Bodleii*, were published as his works by his friend Mr Oldisworth. Mr Smith died in 1710, sunk into indolence and intemperance by poverty and disappointments; the hard fate of many a man of genius.

SMITH (John), an excellent mezzotinter, flourished about 1700; but neither the time of his birth nor death are accurately known. He united softness with strength, and finished with freedom. He served his time with one Tillet a painter in Moorfields; and as soon as he became his own master, learned from Becket the secret of mezzotinto, and being farther instructed by Van der Vaart, was taken to work in Sir Godfrey Kneller's house; and as he was to be the publisher of that master's works, doubtless received considerable hints from him, which he amply repaid. "To posterity perhaps his prints (says Mr Walpole) will carry an idea of something burlesque; perukes of an enormous length flowing over suits of armour, compose wonderful habits. It is equally strange that fashion could introduce the one, and establish the practice of representing the other, when it was out of fashion. Smith excelled in exhibiting both, as he found them in the portraits of Kneller, *Walpole's Catalogue of Engravers.*

Smith. ler, who was leſs happy in what he ſubſtituted to armour. In the Kit-cat club he has poured full bottoms chiefly over night-gowns. If thoſe ſtreams of hair were *incommode* in a battle, I know nothing (he adds) they were adapted to that can be done in a night-gown. Smith compoſed two large volumes, with proofs of his own plates, for which he aſked L. 50. His fineſt works are duke Schomberg on horſeback; that duke's ſon and ſucceſſor Maynhard; the earls of Pembroke, Dorſet, and Albemarle; three plates with two figures in each, of young perſons or children, in which he ſhone; William Cowper; Gibbons and his wife; Queen Anne; the duke of Glouceſter, a whole length, with a flower-pot; a very curious one of Queen Mary, in a high head, fan, and gloves; the earl of Godolphin; the ducheſs of Ormond, a whole length, with a black; Sir George Rooke, &c There is a print by him of James II. with an anchor, but no inſcription; which not being finiſhed when the king went away, is ſo ſcarce that it is ſometimes ſold for above a guinea. Smith alſo performed many hiſtoric pieces; as the loves of the gods, from Titian, at Blenheim, in ten plates; Venus ſtanding in a ſhell, from a picture by Correggio, and many more, of which perhaps the moſt delicate is the holy family with angels, after Carlo Maratti."

Philoſophical Tranſactions of the Royal Society of Edinburgh, vol. iii.

SMITH (Dr Adam), the celebrated author of the Inquiry into the Nature and Cauſes of the Wealth of Nations, was the only ſon of Adam Smith comptroller of the cuſtoms at Kirkaldy, and of Margaret Douglas daughter of Mr Douglas of Strathenry. He was born at Kirkaldy on the 5th June 1723, a few months after the death of his father. His conſtitution during his infancy was infirm and ſickly, and required all the care of his ſurviving parent. When only three years old he was carried by his mother to Strathenry on a viſit to his uncle Mr Douglas; and happening one day to be amuſing himſelf alone at the door of the houſe, he was ſtolen by a party of thoſe vagrants who in Scotland are called *tinkers*. Luckily he was miſſed immediately, and the vagrants purſued and overtaken in Leſlie wood; and thus Dr Smith was preſerved to extend the bounds of ſcience, and reform the commercial policy of Europe.

He received the rudiments of his education in the ſchool of Kirkaldy under David Miller, a teacher of conſiderable eminence, and whoſe name deſerves to be recorded on account of the great number of eminent men which that ſeminary produced while under his direction. Dr Smith, even while at ſchool, attracted notice by his paſſionate attachment to books, and by the extraordinary powers of his memory; while his friendly and generous diſpoſition gained and ſecured the affection of his ſchoolfellows. Even then he was remarkable for thoſe habits which remained with him through life, of ſpeaking to himſelf when alone and of abſence in company. He was ſent in 1737 to the univerſity of Glaſgow, where he remained till 1740, when he went to Baliol college Oxford, as an exhibitioner on Snell's foundation. His favourite purſuits while at the univerſity were mathematics and natural philoſophy. After his removal to England he frequently employed himſelf in tranſlating, particularly from the French, with a view to the improvement of his own ſtyle: a practice which he often recommended to all who wiſhed to cultivate the art of compoſition. It was probably then alſo that he applied himſelf with the greateſt care to the ſtudy of languages, of which, both ancient and modern, his knowledge was uncommonly extenſive and accurate. Smith.

After ſeven years reſidence at Oxford he returned to Kirkaldy, and lived two years with his mother without any fixed plan for his future life. He had been deſigned for the church of England; but diſliking the eccleſiaſtical profeſſion, he reſolved to abandon it altogether, and to limit his ambition to the proſpect of obtaining ſome of thoſe preferments to which literary attainments lead in Scotland. In 1748 he fixed his reſidence in Edinburgh, and for three years read a courſe of lectures on rhetoric and belles lettres under the patronage of Lord Kames. In 1751 he was elected profeſſor of logic in the univerſity of Glaſgow, and the year following was removed to the profeſſorſhip of moral philoſophy, vacant by the death of Mr Thomas Craigie the immediate ſucceſſor of Dr Hutcheſon. In this ſituation he remained 13 years, a period he uſed frequently to look back to as the moſt uſeful part of his life. His lectures on moral philoſophy were divided into four parts: The firſt contained natural theology; in which he conſidered the proofs of the being and attributes of God, and thoſe truths on which religion is founded: the ſecond comprehended ethics, ſtrictly ſo called, and conſiſted chiefly of thoſe doctrines which he afterwards publiſhed in his theory of moral ſentiments: in the third part he treated more at length of that part of morality called *juſtice*; and which, being ſuſceptible of preciſe and accurate rules, is for that reaſon capable of a full and accurate explanation: in the laſt part of his lectures he examined thoſe political regulations which are founded, not upon the principle of juſtice, but of expediency; and which are calculated to increaſe the riches, the power, and the proſperity of a ſtate. Under this view he conſidered the political inſtitutions relating to commerce, to finances, to eccleſiaſtical and military governments: this contained the ſubſtance of his *Wealth of Nations*. In delivering his lectures he truſted almoſt entirely to extemporary elocution: his manner was plain and unaffected, and he never failed to intereſt his hearers. His reputation ſoon roſe very high, and many ſtudents reſorted to the univerſity merely upon his account.

When his acquaintance with Mr Hume firſt commenced is uncertain, but it had ripened into friendſhip before the year 1752.

In 1759 he publiſhed his Theory of Moral Sentiments; a work which deſervedly extended his reputation: for, though ſeveral of its concluſions be ill-founded, it muſt be allowed by all to be a ſingular effort of invention, ingenuity, and ſubtilty. Beſides, it contains a great mixture of important truth; and, tho' the author has ſometimes been miſled, he has had the merit of directing the attention of philoſophers to a view of human nature, which had formerly in a great meaſure eſcaped their notice. It abounds everywhere with the pureſt and moſt elevated maxims concerning the practical conduct of life; and when the ſubject of his work leads him to addreſs the imagination and the heart, the variety and felicity of his illuſtrations, the richneſs and fluency of his eloquence, and the ſkill with

Smith. which he wins the attention and commands the paſſions of his readers, leave him among our Britiſh moraliſts without a rival.

Towards the end of 1763 Dr Smith received an invitation from Mr Charles Townſend to accompany the Duke of Buccleugh on his travels; and the liberal terms in which this propoſal was made induced him to reſign his office at Glaſgow. He joined the Duke of Buccleugh at London early in the year 1764, and ſet out with him for the continent in the month of March following. After a ſtay of about ten days at Paris, they proceeded to Thouloufe, where they fixed their reſidence for about 18 months; thence they went by a pretty extenſive route through the ſouth of France to Geneva, where they paſſed two months. About Chriſtmas 1765 they returned to Paris, and remained there till October following. The ſociety in which Dr Smith paſſed theſe ten months may be conceived in conſequence of the recommendation of Mr Hume. Turgot, Queſnai, Necker, D'Alembert, Helvetius, Marmontel, Madame Riccoboni, were among the number of his acquaintances; and ſome of them he continued ever after to reckon among the number of his friends. In October 1766 the duke of Buccleugh returned to England.

Dr Smith ſpent the next ten years of his life with his mother at Kirkaldy, occupied habitually in intenſe ſtudy, but unbending his mind at times in the company of ſome of his old ſchoolfellows, who ſtill continued to reſide near the place of their birth. In 1776 he publiſhed his *Inquiry into the Nature and Cauſes of the Wealth of Nations;* a book ſo univerſally known, that any panegyric on it would be uſeleſs. The variety, importance, and (may we not add) novelty, of the information which it contains; the ſkill and comprehenſiveneſs of mind diſplayed in the arrangement; the admirable illuſtrations with which it abounds; together with a plainneſs and perſpicuity which makes it intelligible to all—render it unqueſtionably the moſt perfect work which has yet appeared on the general principles of any branch of legiſlation.

He ſpent the next two years of his life in London, where he enjoyed the ſociety of ſome of the moſt eminent men of the age: but he removed to Edinburgh in 1778, in conſequence of having been appointed, at the requeſt of the duke of Buccleugh, one of the commiſſioners of the cuſtoms in Scotland. Here he ſpent the laſt twelve years of his life in an affluence which was more than equal to all his wants. But his ſtudies ſeemed entirely ſuſpended till the infirmities of old age reminded him, when it was too late, of what he yet owed to the public and to his own fame. The principal materials of the works which he had announced had long ago been collected, and little probably was wanting but a few years of health and retirement to complete them. The death of his mother, who had accompanied him to Edinburgh in 1784, together with that of his couſin Miſs Douglas in 1788, contributed to fruſtrate theſe projects. They had been the objects of his affection for more than 60 years, and in their Society he had enjoyed from his infancy all that he ever knew of the endearments of a family. He was now alone and helpleſs; and though he bore his loſs with equanimity, and regained apparently his former cheerfulneſs, yet his health and ſtrength gradually declined till the period of his death, which happened in July 1790. Some days before his death he ordered all his papers to be burnt except a few eſſays, which have ſince been publiſhed. Smith || Smoke.

Of the originality and comprehenſiveneſs of his views; the extent, the variety, and the correctneſs of his information; the inexhauſtible fertility of his invention—he has left behind him laſting monuments. To his private worth, the moſt certain of all teſtimonies may be found in that confidence, reſpect, and attachment, which followed him through all the various relations of life. He was habitually abſent in converſation, and was apt when he ſpoke to deliver his ideas in the form of a lecture. He was rarely known to ſtart a new topic himſelf, or to appear unprepared upon thoſe topics that were introduced by others. In his external form and appearance there was nothing uncommon. When perfectly at eaſe, and when warmed with converſation, his geſtures were animated and not ungraceful; and in the ſociety of thoſe he loved, his features were often brightened by a ſmile of inexpreſſible benignity. In the company of ſtrangers, his tendency to abſence, and perhaps ſtill more his conſciouſneſs of that tendency, rendered his manners ſomewhat embarraſſed; an effect which was probably not a little heightened by thoſe ſpeculative ideas of propriety which his recluſe habits tended at once to perfect in his conception, and to diminiſh his power of realizing.

SMITHIA, in botany: A genus of the *decandria* order, belonging to the *diadelphia* claſs of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The calyx is monophyllous and belabiated; the corolla winged; the legumen incloſed in the calyx, with three or four joints, and contain as many ſeeds, which are ſmooth, compreſſed, and kidney-ſhaped. There is only one ſpecies, viz. the *thonina*.

SMITZ (Gaſpar), who, from painting a great number of Magdalens, was called *Magdalen Smith*, was a Dutch painter, who came to England ſoon after the Reſtoration. For theſe portraits ſat a woman that he kept, and called his wife. A lady, whom he had taught to draw, took him with her to Ireland, where he painted ſmall portraits in oil, had great buſineſs, and high prices. His flowers and fruit were ſo much admired, that one bunch of grapes ſold there for L. 40. In his Magdalens he generally introduced a thiſtle on the fore ground. He had ſeveral ſcholars, particularly Maubert, and one Gawdy of Exeter. Yet, notwithſtanding his ſucceſs, he died poor in Ireland in 1707.

SMITHERY, a ſmith's ſhop; alſo the art of a ſmith, by which iron is wrought into any ſhape by means of fire, hammering, filing, &c.

SMITING-LINE, in a ſhip, is a ſmall rope faſtened to the mizen-yard-arm, below at the deck, and is always furled up with the mizen-ſail, even to the upper end of the yard, and thence it comes down to the poop. Its uſe is to looſe the mizen-ſail without ſtriking down the yard, which is eaſily done, becauſe the mizen-ſail is furled up only with rope-yarns; and therefore when this rope is pulled hard, it breaks all the rope-yarns, and ſo the ſail falls down of itſelf. The ſailor's phraſe is, *ſmite the mizen* (whence this rope takes its name), that is, hale by this rope that the ſail may fall down.

SMOKE, a denſe elaſtic vapour, ariſing from burning bodies. As this vapour is extremely diſagreeable to the ſenſes, and often prejudicial to the health, man-

Smoke. kind have fallen upon ſeveral contrivances to enjoy the benefit of fire, without being annoyed by ſmoke. The moſt univerſal of theſe contrivances is a tube leading from the chamber in which the fire is kindled to the top of the building, through which the ſmoke aſcends, and is diſperſed into the atmoſphere. Theſe tubes are called *chimneys*; which, when conſtructed in a proper manner, carry off the ſmoke entirely; but, when improperly conſtructed, they carry off the ſmoke imperfectly, to the great annoyance of the inhabitants. As our maſons at preſent ſeem to have a very imperfect knowledge of the manner in which chimneys ought to be built, we can hardly perform a more acceptable ſervice to the public than to point out the manner in which they ought to be conſtructed, ſo as to carry off the ſmoke entirely; as well as to explain the cauſes from which the defects ſo often complained of generally proceed, and the method of removing them.

Tranſactions of the American Philoſophical Society.

Thoſe who would be acquainted with this ſubject, ſhould begin by conſidering on what principle ſmoke aſcends in any chimney. At firſt many are apt to think that ſmoke is in its nature, and of itſelf, ſpecifically lighter than air, and riſes in it for the ſame reaſon that cork riſes in water. Theſe ſee no cauſe why ſmoke ſhould not riſe in the chimney though the room be ever ſo cloſe. Others think there is a power in chimneys to *draw* up the ſmoke, and that there are different forms of chimneys which afford more or leſs of this power. Theſe amuſe themſelves with ſearching for the beſt form. The equal dimenſions of a funnel in its whole length is not thought artificial enough, and it is made, for fancied reaſons, ſometimes tapering and narrowing from below upwards, and ſometimes the contrary, &c. &c. A ſimple experiment or two may ſerve to give more correct ideas. Having lighted a pipe of tobacco, plunge the ſtem to the bottom of a decanter half filled with cold water; then putting a rag over the bowl, blow through it, and make the ſmoke deſcend in the ſtem of the pipe, from the end of which it will riſe in bubbles through the water; and being thus cooled, will not afterwards riſe to go out through the neck of the decanter, but remain ſpreading itſelf and reſting on the ſurface of the water. This ſhows that ſmoke is really heavier than air, and that it is carried upwards only when attached to or acted upon by air that is heated, and thereby rarefied and rendered ſpecifically lighter than the air in its neighbourhood.

Smoke being rarely ſeen but in company with heated air, and its upward motion being viſible, though that of the rarefied air that drives it is not ſo, has naturally given riſe to the error. It is now well known that air is a fluid which has weight as well as others, though about 800 times lighter than water; that heat makes the particles of air recede from each other, and take up more ſpace, ſo that the ſame weight of air heated will have more bulk than equal weights of cold air which may ſurround it, and in that caſe muſt riſe, being forced upwards by ſuch colder and heavier air, which preſſes to get under it and take its place. That air is ſo rarefied or expanded by heat, may be proved to their comprehenſion by a lank blown bladder, which laid before a fire, will ſoon ſwell, grow tight, and burſt.

Plate CCCCLXXI. fig. 1. Another experiment may be to take a glaſs tube about an inch in diameter, and 12 inches long, open at both ends, and fixed upright on legs ſo that it need not be handled, for the hands might warm it. At the end of a quill faſten five or ſix inches of the fineſt light filament of ſilk, ſo that it may be held either above the upper end of the tube or under the lower end, your warm hand being at a diſtance by the length of the quill. If there were any motion of air through the tube, it would manifeſt itſelf by its effect on the ſilk; but if the tube and the air in it are of the ſame temperature with the ſurrounding air, there will be no ſuch motion, whatever may be the form of the tube, whether crooked or ſtraight, narrow below and widening upwards, or the contrary, the air in it will be quieſcent. Warm the tube, and you will find as long as it continues warm, a conſtant current of air entering below and paſſing up through it till diſcharged at the top; becauſe the warmth of the tube being communicated to the air it contains, rarefies that air, and makes it lighter than the air without; which therefore preſſes in below, forces it upwards, follows and takes its place, and is rarefied in its turn. And, without warming the tube, if you hold under it a knob of hot iron, the air thereby heated will riſe and fill the tube, going out at its top; and this motion in the tube will continue as long as the knob remains hot, becauſe the air entering the tube below, is heated and rarefied by paſſing near and over that knob. Smoke.

That this motion is produced merely by the difference of ſpecific gravity between the fluid within and that without the tube, and not by any fancied form of the tube itſelf, may appear by plunging it into water contained in a glaſs jar a foot deep, through which ſuch motion might be ſeen, The water within and without the tube being of the ſame ſpecific gravity, balance each other, and both remain at reſt. But take out the tube, ſtop its bottom with a finger, and fill it with olive oil, which is lighter than water; then ſtopping the top, place it as before, its lower end under water, its top a very little above. As long as you keep the bottom ſtopped the fluids remain at reſt; but the moment it is unſtopt, the heavier enters below, forces up the lighter, and takes its place: and the motion then ceaſes, merely becauſe the new fluid cannot be ſucceſſively made lighter, as air may be by a warm tube.

In fact, no form of the funnel of a chimney has any ſhare in its operation or effect reſpecting ſmoke except its height. The longer the funnel, if erect, the greater its force when filled with heated and rarefied air to draw in below and drive up the ſmoke, if one may, in compliance with cuſtom, uſe the expreſſion *draw*, when in fact it is the ſuperior weight of the ſurrounding atmoſphere that preſſes to enter the funnel below, and ſo drives up before it the ſmoke and warm air it meets with in its paſſage.

What is it then which makes a ſmoky chimney, that is, a chimney which, inſtead of conveying up all the ſmoke, diſcharges a part of it into the room, offending the eyes and damaging the furniture?

The cauſes of this effect may be reduced to *nine*, differing from each other, and therefore requiring different remedies.

1. *Smoky chimneys in a new houſe are ſuch frequently from mere want of air.* The workmanſhip of the rooms being all good, and juſt out of the workman's hands, the joints of the boards of the flooring, and of the pannels of wainſcotting, are all true and tight; the more ſo as the

Smoke. the walls, perhaps not yet thoroughly dry, preſerve a dampneſs in the air of the room which keeps the wood-work ſwelled and cloſe. The doors and the ſaſhes too, being worked with truth, ſhut with exactneſs, ſo that the room is as tight as a ſnuff-box, no paſſage being left open for air to enter except the key-hole, and even that is ſometimes covered by a little dropping ſhutter. Now if ſmoke cannot riſe but as connected with rarefied air, and a column of ſuch air, ſuppoſe it filling the funnel, cannot riſe unleſs other air be admitted to ſupply its place; and if therefore no current of air enter the opening of the chimney—there is nothing to prevent the ſmoke from coming out into the room. If the motion upwards of the air in a chimney that is freely ſupplied be obſerved by the riſing of the ſmoke or a feather in it, and it be conſidered that in the time ſuch feather takes in riſing from the fire to the top of the chimney, a column of air equal to the content of the funnel muſt be diſcharged, and an equal quantity ſupplied from the room below, it will appear abſolutely impoſſible that this operation ſhould go on if the tight room is kept ſhut; for were there any force capable of drawing conſtantly ſo much air out of it, it muſt ſoon be exhauſted like the receiver of an air-pump, and no animal could live in it. Thoſe therefore who ſtop every crevice in a room to prevent the admiſſion of freſh air, and yet would have their chimney carry up the ſmoke, require inconſiſtencies, and expect impoſſibilities. Yet under this ſituation it is not uncommon to ſee the owner of a new houſe in deſpair, and ready to ſell it for much leſs than it coſt; conceiving it uninhabitable becauſe not a chimney in any one of its rooms will carry off the ſmoke unleſs a door or window be left open. Much expence has alſo been made to alter and amend new chimneys which had really no fault: in one houſe particularly which Dr Franklin knew that belonged to a nobleman in Weſtminſter, that expence amounted to no leſs than L. 300, after his houſe had been, as he thought, finiſhed and all charges paid. And after all, ſeveral of the alterations were ineffectual, for want of underſtanding the true principles.

Remedies. When you find on trial that opening the door or a window enables the chimney to carry up all the ſmoke, you may be ſure that want of air from without was the cauſe of its ſmoking. "I ſay from *without* (adds Dr Franklin), to guard you againſt a common miſtake of thoſe who may tell you the room is large, contains abundance of air ſufficient to ſupply any chimney, and therefore it cannot be that the chimney wants air. Theſe reaſoners are ignorant that the largeneſs of a room, if tight, is in this caſe of ſmall importance, ſince it cannot part with a chimney full of its air without occaſioning ſo much vacuum; which it requires a great force to effect, and could not be borne if effected."

It appearing plainly then, that ſome of the outward air muſt be admitted, the queſtion will be, how much is abſolutely neceſſary? for you would avoid admitting more, as being contrary to one of your intentions in having a fire, viz. that of warming your room. To diſcover this quantity, ſhut the door gradually while a middling fire is burning, till you find that before it is quite ſhut the ſmoke begins to come out into the room; then open it a little till you perceive the ſmoke comes out no longer. There hold the door, and obſerve the width of the open crevice between the edge of the door and the rabbet it ſhould ſhut into. Suppoſe the diſtance to be half an inch, and the door eight feet high; you find thence that your room requires an entrance for air equal in area to 96 half-inches, or 48 ſquare inches, or a paſſage of 6 inches by 8. This, however, is a large ſuppoſition; there being few chimneys that, having a moderate opening and a tolerable height of funnel, will not be ſatisfied with ſuch a crevice of a quarter of an inch: Dr Franklin found a ſquare of 6 by 6, or 36 ſquare inches, to be a pretty good medium that will ſerve for moſt chimneys. High funnels with ſmall and low openings may indeed be ſupplied through a leſs ſpace; becauſe, for reaſons that will appear hereafter, the force of levity, if one may ſo ſpeak, being greater in ſuch funnels, the cool air enters the room with greater velocity, and conſequently more enters in the ſame time. This, however, has its limits; for experience ſhows, that no increaſed velocity ſo occaſioned has made the admiſſion of air through the key-hole equal in quantity to that through an open door, though through the door the current moves ſlowly, and through the key-hole with great rapidity. Smoke.

It remains then to be conſidered, how and where this neceſſary quantity of air from without is to be admitted ſo as to be leaſt inconvenient: for if at the door, left ſo much open, the air thence proceeds directly to the chimney, and in its way comes cold to your back and heels as you ſit before your fire. If you keep the door ſhut, and raiſe a little the ſaſh of your window, you feel the ſame inconvenience. Various have been the contrivances to avoid this; ſuch as bringing in freſh air through pipes in the jams of the chimney, which pointing upwards ſhould blow the ſmoke up the funnel; opening paſſages into the funnel above, to let in air for the ſame purpoſe. But theſe produce an effect contrary to that intended: for as it is the conſtant current of air paſſing from the room through the opening of the chimney into the funnel which prevents the ſmoke from coming out into the room, if you ſupply the funnel by other means or in other ways with the air which it wants, and eſpecially if that air be cold, you diminiſh the force of that current, and the ſmoke in its efforts to enter the room finds leſs reſiſtance.

The wanted air muſt then indiſpenſably be admitted into the room, to ſupply what goes off through the opening of the chimney. M. Gauger, a very ingenious and intelligent French writer on the ſubject, propoſes with judgment to admit it above the opening of the chimney; and to prevent inconvenience from its coldneſs, he directs that it may be ſo made, that it ſhall paſs in its entrance through winding cavities made behind the iron back and ſides of the fire-place, and under the iron hearth-plate; in which cavities it will be warmed, and even heated, ſo as to contribute much, inſtead of cooling, to the warming of the room. This invention is excellent in itſelf, and may be uſed with advantage in building new houſes; becauſe the chimneys may then be ſo diſpoſed as to admit conveniently the cold air to enter ſuch paſſages: but in houſes built without ſuch views, the chimneys are often ſo ſituated as not to afford that convenience without great and expenſive alterations. Eaſy and cheap methods, though not quite ſo perfect in themſelves, are of more general utility; and ſuch are the following.

In

Smoke. In all rooms where there is a fire, the body of air warmed and rarefied before the chimney is continually changing place, and making room for other air that is to be warmed in its turn. Part of it enters and goes up the chimney, and the reſt riſes and takes place near the ceiling. If the room be lofty, that warm air remains above our heads as long as it continues warm, and we are little benefited by it, becauſe it does not deſcend till it is cooler. Few can imagine the difference of climate between the upper and lower parts of ſuch a room, who have not tried it by the thermometer, or by going up a ladder till their heads are near the ceiling. It is then among this warm air that the wanted quantity of outward air is beſt admitted, with which being mixed, its coldneſs is abated, and its inconvenience diminiſhed ſo as to become ſcarce obſervable. This may be eaſily done by drawing down about an inch the upper ſaſh of a window; or, if not moveable, by cutting ſuch a crevice through its frame; in both which caſes it will be well to place a thin ſhelf of the length to conceal the opening, and ſloping upwards, to direct the entering air horizontally along and under the ceiling. In ſome houſes the air may be admitted by ſuch a crevice made in the wainſcot, cornice, or plaſtering, near the ceiling and over the opening of the chimney. This, if practicable, is to be choſen, becauſe the entering cold air will there meet with the warmeſt riſing air from before the fire, and be ſooneſt tempered by the mixture. The
Fig. 2. ſame kind of ſhelf ſhould alſo be placed here. Another way, and not a very difficult one, is to take out an upper pane of glaſs in one of your ſaſhes, ſet it in a tin frame, giving it two ſpringing angular ſides, and then replacing it, with hinges below on which it may be turned to open more or leſs above. It will then have the appearance of an internal ſky-light. By drawing this pane in, more or leſs, you may admit what air you find neceſſary. Its poſition will naturally throw that air up and along the ceiling. This is what is called in France a *Was iſt das?* As this is a German queſtion, the invention is probably of that nation, and takes its name from the frequent aſking of that queſtion when it firſt appeared. In England ſome have of late years cut a round hole about five inches diameter in a pane of the ſaſh and placed againſt it a circular plate of tin hung on an axis, and cut into vanes; which, being ſeparately bent a little obliquely, are acted upon by the entering air, ſo as to force the plate continually round like the vanes of a windmill. This admits the outward air, and by the continual whirling of the vanes, does in ſome degree diſperſe it. The noiſe only is a little inconvenient.

2. A ſecond cauſe of the ſmoking of chimneys is, *their openings in the room being too large*; that is, too wide, too high, or both. Architects in general have no other ideas of proportion in the opening of a chimney than what relate to ſymmetry and beauty reſpecting the dimenſions of the room; while its true proportion reſpecting its function and utility depends on quite other principles; and they might as properly proportion the ſtep in a ſtaircaſe to the height of the ſtory, inſtead of the natural elevation of mens legs in mounting. The proportion then to be regarded, is what relates to the height of the funnel. For as the funnels in the different ſtories of a houſe are neceſſarily of different heights or lengths, that from the loweſt floor being the higheſt or longeſt, and thoſe of the other floors ſhorter and ſhorter, till we we come to thoſe in the garrets, which are of courſe the ſhorteſt; and the force of draft being, as already ſaid, in proportion to the height of funnel filled with rarefied air, and a current of air from the room into the chimney, ſufficient to fill the opening, being neceſſary to oppoſe and prevent the ſmoke from coming out into the room; it follows, that the openings of the longeſt funnels may be larger, and that thoſe of the ſhorter funnels ſhould be ſmaller. For if there be a large opening to a chimney that does not draw ſtrongly, the funnel may happen to be furniſhed with the air which it demands by a partial current entering on one ſide of the opening, and leaving the other ſide free of any oppoſing current, may permit the ſmoke to iſſue there into the room. Much too of the force of draft in a funnel depends on the degree of rarefaction in the air it contains, and that depends on the nearneſs to the fire of its paſſage in entering the funnel. If it can enter far from the fire on each ſide, or far above the fire, in a wide or high opening, it receives little heat in paſſing by the fire, and the contents of the funnel are by thoſe means leſs different in levity from the ſurrounding atmoſphere, and its force in drawing conſequently weaker. Hence if too large an opening be given to chimneys in upper rooms, thoſe rooms will be ſmoky: On the other hand, if too ſmall openings be given to chimneys in the lower rooms, the entering air operating too directly and violently on the fire, and afterwards ſtrengthening the draft as it aſcends the funnel, will conſume the fuel too rapidly.

Remedy. As different circumſtances frequently mix themſelves in theſe matters, it is difficult to give preciſe dimenſions for the openings of all chimneys. Our fathers made them generally much too large: we have leſſened them; but they are often ſtill of greater dimenſions than they ſhould be, the human eye not being eaſily reconciled to ſudden and great changes. If you ſuſpect that your chimney ſmokes from the too great dimenſion of its opening, contract it by placing moveable boards ſo as to lower and narrow it gradually till you find the ſmoke no longer iſſues into the room. The proportion ſo found will be that which is proper for that chimney, and you may employ the bricklayer or maſon to reduce it accordingly. However, as in building new houſes ſomething muſt be ſometimes hazarded, Dr Franklin propoſes to make the openings in the lower rooms about 30 inches ſquare and 18 deep, and thoſe in the upper only 18 inches ſquare and not quite ſo deep; the intermediate ones diminiſhing in proportion as the height of the funnel is diminiſhed. In the larger openings, billets of two feet long, or half the common length of cordwood, may be burnt conveniently; and for the ſmaller, ſuch wood may be ſawed into thirds. Where coals are the fuel, the grates will be proportioned to the openings. The ſame depth is nearly neceſſary to all, the funnels being all made of a ſize proper to admit a chimney-ſweeper. If in large and elegant rooms cuſtom or fancy ſhould require the appearance of a larger chimney, it may be formed of expenſive marginal decorations, in marble, &c. But in time perhaps, that which is fitteſt in the nature of things may come to be thought handſomeſt.

3. Another cauſe of ſmoky chimneys is *too ſhort a funnel.* This happens neceſſarily in ſome caſes, as where

Smoke. a chimney is required in a low building; for, if the funnel be raiſed high above the roof, in order to ſtrengthen its draft, it is then in danger of being blown down, and cruſhing the roof in its fall.

Remedies. Contract the opening of the chimney, ſo as to oblige all the entering air to paſs through or very near the fire; whereby it will be more heated and rarefied, the funnel itſelf be more warmed, and its contents have more of what may be called the force of levity, ſo as to riſe ſtrongly and maintain a good draft at the opening.

Or you may in ſome caſes, to advantage, build additional ſtories over the low building, which will ſupport a high funnel.

If the low building be uſed as a kitchen, and a contraction of the opening therefore inconvenient, a large one being neceſſary, at leaſt when there are great dinners, for the free management of ſo many cooking utenſils; in ſuch caſe the beſt expedient perhaps would be to build two more funnels joining to the firſt, and having three moderate openings, one to each funnel, inſtead of one large one. When there is occaſion to uſe but one, the other two may be kept ſhut by ſliding plates, hereafter to be deſcribed; and two or all of them may be uſed together when wanted. This will indeed be an expence, but not an uſeleſs one, ſince your cooks will work with more comfort, ſee better than in a ſmoky kitchen what they are about, your victuals will be cleaner dreſſed and not taſte of ſmoke, as is often the caſe; and to render the effect more certain, a ſtack of three funnels may be ſafely built higher above the roof than a ſingle funnel.

The caſe of too ſhort a funnel is more general than would be imagined, and often found where one would not expect it. For it is not uncommon, in ill-contrived buildings, inſtead of having a funnel for each room or fire-place, to bend and turn the funnel of an upper room ſo as to make it enter the ſide of another funnel that comes from below. By theſe means the upper room funnel is made ſhort of courſe, ſince its length can only be reckoned from the place where it enters the lower room funnel; and that funnel is alſo ſhortened by all the diſtance between the entrance of the ſecond funnel and the top of the ſtack: for all that part being readily ſupplied with air through the ſecond funnel, adds no ſtrength to the draft, eſpecially as that air is cold when there is no fire in the ſecond chimney. The only eaſy remedy here is, to keep the opening of that funnel ſhut in which there is no fire.

4. Another very common cauſe of the ſmoking of chimneys is, *their overpowering one another.* For inſtance, if there be two chimneys in one large room, and you make fires in both of them, the doors and windows cloſe ſhut, you will find that the greater and ſtronger fire ſhall overpower the weaker, from the funnel of which it will draw air down to ſupply its own demand; which air deſcending in the weaker funnel, will drive down its ſmoke, and force it into the room. If, inſtead of being in one room, the two chimneys are in two different rooms, communicating by a door, the caſe is the ſame whenever that door is open. In a very tight houſe, a kitchen chimney on the loweſt floor, when it had a great fire in it, has been known to overpower any other chimney in the houſe, and draw air and ſmoke into its room as often as the door communicating with the ſtaircaſe was opened. Smoke.

Remedy. Take care that every room have the means of ſupplying itſelf from without with the air which its chimney may require, ſo that no one of them may be obliged to borrow from another, nor under the neceſſity of lending. A variety of theſe means have been already deſcribed.

5. Another cauſe of ſmoking is, *when the tops of chimneys are commanded by higher buildings, or by a hill,* ſo that the wind blowing over ſuch eminences falls like water over a dam, ſometimes almoſt perpendicularly on the tops of the chimneys that lie in its way, and beats down the ſmoke contained in them.

To illuſtrate this, let A (fig. 3.) repreſent a ſmall building at the ſide of a great rock B, and the wind coming in the direction CD; when the current of air comes to the point D, being hurried forward with great velocity, it goes a little forward, but ſoon deſcends downward, and gradually is reflected more and more inward, as repreſented by the dotted lines EE, &c. ſo that, deſcending downwards upon the top of the chimney A, the ſmoke is beat back again into the apartments.

It is evident that houſes ſituated near high hills or thick woods will be in ſome meaſure expoſed to the ſame inconvenience; but it is likewiſe plain, that if a houſe be ſituated upon the ſlope of a hill (as at F, fig. 3.), it will not be in any danger of ſmoke when the wind blows towards that ſide of the hill upon which it is ſituated; for the current of air coming over the houſe-top in the direction GH, is immediately changed by the ſlope of the hill to the direction HC, which powerfully draws the ſmoke upward from the top of the chimney. But it is alſo evident, that a houſe in this ſituation will be liable to ſmoke when the wind blows from the hill; for the current of air coming downward in the direction CH, will beat downward on the chimney F, and prevent the ſmoke from aſcending with freedom. The effect will be much heightened if the doors and windows are chiefly in the lowermoſt ſide of the houſe.

Remedy. That commonly applied to this caſe is a turncap made of tin or plate iron, covering the chimney above and on three ſides, open on one ſide, turning on a ſpindle; and which being guided or governed by a vane always preſents its back to the current. This may be generally effectual, though not certain, as there may be caſes in which it will not ſucceed. Raiſing your funnels if practicable, ſo as their tops may be higher, or at leaſt equal, with the commanding eminence, is more to be depended on. But the turning cap, being eaſier and cheaper, ſhould firſt be tried. "If obliged to build in ſuch a ſituation, I would chooſe (ſays Dr Franklin) to place my doors on the ſide next the hill, and the backs of my chimneys on the fartheſt ſide; for then the column of air falling over the eminence, and of courſe preſſing on that below, and forcing it to enter the doors or *was-iſt-daſes* on that ſide, would tend to balance the preſſure down the chimneys, and leave the funnels more free in the exerciſe of their functions."

6. There is another caſe which is the reverſe of that laſt mentioned. It is where the commanding eminence is

Smoke. Fig. 4.

is farther from the wind than the chimney commanded. To explain this a figure may be neceſſary. Suppoſe then a building whoſe ſide AB happens to be expoſed to the wind, and forms a kind of dam againſt its progreſs. Suppoſe the wind blowing in the direction FE. The air obſtructed by this dam or building AB will like water preſs and ſearch for paſſages through it; but finding none, it is beat back with violence, and ſpreads itſelf on every ſide, as is repreſented by the curved lines *e*, *e*, *e*, *e*, *e*, *e*. It will therefore force itſelf down the ſmall chimney C, in order to get through by ſome door or window open on the other ſide of the building. And if there be a fire in ſuch chimney, its ſmoke is of courſe beat down, and fills the room.

Remedy. There is but one remedy, which is to raiſe ſuch a funnel higher than the roof, ſupporting it if neceſſary by iron bars. For a turncap in this caſe has no effect, the dammed up air preſſing down through it in whatever poſition the wind may have placed its opening.

Dr Franklin mentions a city in which many houſes are rendered ſmoky by this operation. For their kitchens being built behind, and connected by a paſſage with the houſes, and the tops of the kitchen-chimneys lower than the tops of the houſes, the whole ſide of a ſtreet when the wind blows againſt its back forms ſuch a dam as above deſcribed; and the wind ſo obſtructed forces down thoſe kitchen-chimneys (eſpecially when they have but weak fires in them) to paſs through the paſſage and houſe into the ſtreet. Kitchen chimneys ſo formed and ſituated have another inconvenience. In ſummer, if you open your upper room windows for air, a light breeze blowing over your kitchen chimney towards the houſe, though not ſtrong enough to force down its ſmoke as aforeſaid, is ſufficient to waft it into your windows, and fill the rooms with it; which, beſides the diſagreeableneſs, damages your furniture.

7. Chimneys, otherwiſe drawing well, are ſometimes made to ſmoke by *the improper and inconvenient ſituation of a door*. When the door and chimney are on the ſame ſide of the room, if the door being in the corner is made to open againſt the wall, which is common, as being there, when open, more out of the way, it follows, that when the door is only opened in part, a current of air ruſhing in paſſes along the wall into and acroſs the opening of the chimney, and flirts ſome of the ſmoke out into the room. This happens more certainly when the door is ſhutting, for then the force of the current is augmented, and becomes very inconvenient to thoſe who, warming themſelves by the fire, happen to ſit in its way.

The *remedies* are obvious and eaſy. Either put an intervening ſcreen from the wall round great part of the fireplace; or, which is perhaps preferable, ſhift the hinges of your door, ſo as it may open the other way, and when open throw the air along the other wall.

8. A room that has no fire in its chimney is ſometimes filled with *ſmoke which is received at the top of its funnel, and deſcends into the room*. Funnels without fires have an effect according to their degree of coldneſs or warmth on the air that happens to be contained in them. The ſurrounding atmoſphere is frequently changing its temperature; but ſtacks of funnels covered from winds and ſun by the houſe that contains them, retain a more equal temperature. If, after a warm ſeaſon, the outward air ſuddenly grows cold, the empty warm funnels begin to draw ſtrongly upward; that is, they rarefy the air contained in them, which of courſe riſes, cooler air enters below to ſupply its place, is rarefied in its turn, and riſes; and this operation continues till the funnel grows cooler, or the outward air warmer, or both, when the motion ceaſes. On the other hand, if after a cold ſeaſon the outward air ſuddenly grows warm and of courſe lighter, the air contained in the cool funnels being heavier deſcends into the room; and the warmer air which enters their tops being cooled in its turn, and made heavier, continues to deſcend; and this operation goes on till the funnels are warmed by the paſſing of warm air thro' them, or the air itſelf grows cooler. When the temperature of the air and of the funnels is nearly equal, the difference of warmth in the air between day and night is ſufficient to produce theſe currents: the air will begin to aſcend the funnels as the cool of the evening comes on, and this current will continue till perhaps nine or ten o'clock the next morning, when it begins to heſitate; and as the heat of the day approaches, it ſets downwards, and continues ſo till towards evening, when it again heſitates for ſome time, and then goes upwards conſtantly during the night, as before mentioned. Now when ſmoke iſſuing from the tops of neighbouring funnels paſſes over the tops of funnels which are at the time drawing downwards, as they often are in the middle part of the day, ſuch ſmoke is of neceſſity drawn into theſe funnels, and deſcends with the air into the chamber. Smoke.

The remedy is to have a ſliding plate that will ſhut perfectly the offending funnel. Dr Franklin has thus deſcribed it: "The opening of the chimney is contracted by brick-work faced with marble ſlabs to about two feet between the jams, and the breaſt brought down to within about three feet of the hearth. An iron frame is placed juſt under the breaſt, and extending quite to the back of the chimney, ſo that a plate of the ſame metal may ſlide horizontally backwards and forwards in the grooves on each ſide of the frame. This plate is juſt ſo large as to fill the whole ſpace, and ſhut the chimney entirely when thruſt quite in, which is convenient when there is no fire. Draw it out, ſo as to leave between its further edge and the back a ſpace of about two inches; this ſpace is ſufficient for the ſmoke to paſs; and ſo large a part of the funnel being ſtopt by the reſt of the plate, the paſſage of warm air out of the room, up the chimney, is obſtructed and retarded; and by thoſe means much cold air is prevented from coming in through crevices, to ſupply its place. This effect is made manifeſt three ways. 1. When the fire burns briſkly in cold weather, the howling or whiſtling noiſe made by the wind, as it enters the room through the crevices, when the chimney is open as uſual, ceaſes as ſoon as the plate is ſlid in to its proper diſtance. 2. Opening the door of the room about half an inch, and holding your hand againſt the opening, near the top of the door, you feel the cold air coming in againſt your hand, but weakly, if the plate be in. Let another perſon ſuddenly draw it out, ſo as to let the air of the room go up the chimney, with its uſual freedom where chimneys are open, and you immediately feel the cold air ruſhing in ſtrongly. 3. If ſomething be ſet againſt the door, juſt ſufficient, when the plate is in, to keep the door nearly ſhut, by reſiſting the preſſure of the air

Smoke. air that would force it open: then, when the plate is drawn out, the door will be forced open by the increased pressure of the outward cold air endeavouring to get in to supply the place of the warm air that now passes out of the room to go up the chimney. In our common open chimneys, half the fuel is wasted, and its effect lost; the air it has warmed being immediately drawn off."

9. Chimneys which generally draw well, do nevertheless sometimes give smoke into the rooms, *it being driven down by strong winds passing over the tops of their funnels*, though not descending from any commanding eminence. This case is most frequent where the funnel is short and the opening turned from the wind. It is the more grievous, when it happens to be a cold wind that produces the effect, because when you most want your fire you are sometimes obliged to extinguish it. To understand this, it may be considered that the rising light air, to obtain a free issue from the funnel, must push out of its way or oblige the air that is over it to rise. In a time of calm or of little wind this is done visibly; for we see the smoke that is brought up by that air rise in a column above the chimney: but when a violent current of air, that is, a strong wind, passes over the top of a chimney, its particles have received so much force, which keeps them in a horizontal direction and follow each other so rapidly, that the rising light air has not strength sufficient to oblige them to quit that direction and move upwards to permit its issue.

Remedies. In Venice, the custom is to open or widen the top of the flue rounding it in the true form of a funnel. In other places the contrary is practised; the tops of the flues being narrowed inwards, so as to form a slit for the issue of the smoke, long as the breadth of the funnel, and only four inches wide. This seems to have been contrived on a supposition that the entry of the wind would thereby be obstructed and perhaps it might have been imagined, that the whole force of the rising warm air being condensed, as it were, in the narrow opening, would thereby be strengthened, so as to overcome the resistance of the wind. This, however, did not always succeed; for when the wind was at north-east and blew fresh, the smoke was forced down by fits into the room where Dr Franklin commonly sat, so as to oblige him to shift the fire into another. The position of the slit of this funnel was indeed north-east and south-west. Perhaps it it had lain across the wind, the effect might have been different. But on this we can give no certainty. It seems a matter proper to be referred to experiment. Possibly a turncap might have been serviceable, but it was not tried.

With all the science, however, that a man shall suppose himself possessed of in this article, he may sometimes meet with cases that shall puzzle him. "I once lodged (says Dr Franklin) in a house at London, which in a little room had a single chimney and funnel. The opening was very small, yet it did not keep in the smoke, and all attempts to have a fire in this room were fruitless. I could not imagine the reason, till at length observing that the chamber over it, which had no fireplace in it, was always filled with smoke when a fire was kindled below, and that the smoke came through the cracks and crevices of the wainscot; I had the wainscot taken down, and discovered that the funnel which went up behind it had a crack many feet in length, and wide enough to admit my arm; a breach very dangerous with regard to fire, and occasioned probably by an apparent irregular settling of one side of the house. The air entering this breech freely, destroyed the drawing force of the funnel. The remedy would have been, filling up the breach, or rather rebuilding the funnel: but the landlord rather chose to stop up the chimney. Smoke-Jack.

"Another puzzling case I met with at a friend's country house near London. His best room had a chimney in which, he told me, he never could have a fire, for all the smoke came out into the room. I flattered myself I could easily find the cause and prescribe the cure. I had a fire made there, and found it as he said. I opened the door, and perceived it was not want of air. I made a temporary contraction of the opening of the chimney, and found that it was not its being too large that caused the smoke to issue. I went out and looked up at the top of the chimney: Its funnel was joined in the same stack with others; some of them shorter, that drew very well, and I saw nothing to prevent its doing the same. In fine, after every other examination I could think of, I was obliged to own the insufficiency of my skill. But my friend, who made no pretension to such kind of knowledge, afterwards discovered the cause himself. He got to the top of the funnel by a ladder, and looking down found it filled with twigs and straw cemented by earth and lined with feathers. It seems the house, after being built, had stood empty some years before he occupied it; and he concluded that some large birds had taken the advantage of its retired situation to make their nest there. The rubbish, considerable in quantity, being removed, and the funnel cleared, the chimney drew well, and gave satisfaction."

Chimneys whose funnels go up in the north wall of a house, and are exposed to the north winds, are not so apt to draw well as those in a south wall; because when rendered cold by those winds, they draw downwards.

Chimneys inclosed in the body of a house are better than those whose funnels are exposed in cold walls.

Chimneys in stacks are apt to draw better than separate funnels, because the funnels that have constant fires in them warm the others in some degree that have none.

Smoke-Jack. This ingenious machine is of German extraction; and Messinger, in his *Collection of Mechanical Performances*, says it is very ancient, being represented in a painting at Nurenbergh, which is known to be older than the year 1350.

Its construction is abundantly simple. An upright iron spindle GA (fig. 5.), placed in the narrow part of the kitchen chimney, turns round on two pivots H and I. The upper one H passes through an iron bar, which is built in across the chimney; and the lower pivot I is of tempered steel, and is conical or pointed, resting in a conical bell-metal socket fixed on another cross bar. On the upper end of the spindle is a circular fly G, consisting of 4, 6, 8, or more thin iron plates, set obliquely on the spindle like the sails of a windmill, as we shall describe more particularly by and by. Near the lower end of the spindle is a pinion A, which works in the teeth of a contrate or face wheel B, turning on a horizontal axis BC. One pivot of this axis turns in a cock fixed on the cross bar, which supports the lower end of the upright spindle HI, and the other pivot Plate CCCCLXXI.

Smoke-Jack.

turns in a cock fixed on the ſide wall of the chimney; ſo that this axle is parallel to the front of the chimney. On the remote end of this horizontal axle there is a ſmall pulley C, having a deep angular groove. Over this pulley there paſſes a chain CDE, in the lower bight of which hangs the large pulley E of the ſpit. This end of the ſpit turns looſely between the branches of the fork of the rack or raxe F, but without reſting on it. This is on the top of a moveable ſtand, which can be ſhifted nearer to or farther from the fire. The other end turns in one of the notches of another rack. The number of teeth in the pinion A and wheel B, and the diameters of the pulleys C and E, are ſo proportioned that the fly G makes from 12 to 20 turns for one turn of the ſpit.

The manner of operation of this uſeful machine is eaſily underſtood. The air which contributes to the burning of the fuel, and paſſes through the midſt of it, is greatly heated, and expanding prodigiouſly in bulk, becomes lighter than the neighbouring air, and is therefore puſhed by it up the chimney. In like manner, all the air which comes near the fire is heated, expanded, becomes lighter, and is driven up the chimney. This is called the *draught* or *ſuction*, but would with greater propriety be termed the *drift* of the chimney. As the chimney gradually contracts in its dimenſions, and as the ſame quantity of heated air paſſes through every ſection of it, it is plain that the rapidity of its aſcent muſt be greateſt in the narroweſt place. There the fly G ſhould be placed, becauſe it will there be expoſed to the ſtrongeſt current. This air, ſtriking the fly vanes obliquely, puſhes them aſide, and thus turns them round with a conſiderable force. If the joint of meat is exactly balanced on the ſpit, it is plain that the only reſiſtance to the motion of the fly is what ariſes from the friction of the pivots of the upright ſpindle, the friction of the pinion and wheel, the friction of the pivots of the horizontal axis, the friction of the ſmall end of the ſpit, and the friction of the chain in the two pulleys. The whole of this is but a mere trifle. But there is frequently a conſiderable inequality in the weight of the meat on different ſides of the ſpit: there muſt therefore be a ſufficient overplus of force in the impulſe of the aſcending air on the vanes of the fly, to overcome this want of equilibrium occaſioned by the unſkilfulneſs or negligence of the cook. There is, however, commonly enough of power when the machine is properly conſtructed. The utility of this machine will, we hope, procure us the indulgence of ſome of our readers, while we point out the circumſtances on which its performance depends, and the maxims which ſhould be followed in its conſtruction.

The upward current of air is the moving power, and ſhould be increaſed as much as poſſible, and applied in the moſt advantageous manner. Every thing will increaſe the current which improves the draught of the chimney, and ſecures it from ſmoking. A ſmoky chimney muſt always have a weak current. For this particular, therefore, we refer to what has been delivered in the article PNEUMATICS, n° 359; and in the article SMOKE.

With reſpect to the manner of applying this force, it is evident that the beſt conſtruction of a windmill ſails will be nearly the beſt conſtruction for the fly. According to the uſual theory of the impulſe of fluids, the greateſt effective impulſe (that is, in the direction of the fly's motion) will be produced if the plane of the vane be inclined to the axis in an angle of 54 degrees 46 minutes. But, ſince we have pronounced this theory to be ſo very defective, we had better take a determination founded on the experiments on the impulſe of fluids made by the academy of Paris. Theſe authoriſe us to ſay, that 49½ or 50 degrees will be the beſt angle to give the vane: but this muſt be underſtood only of that part of it which is cloſe adjoining to the axis. The vane itſelf muſt be twiſted, or *weathered* as the millwrights term it, and muſt be much more oblique at its outer extremity. The exact poſition cannot be determined with any preciſion; becauſe this depends on the proportion of the velocity of the vane to that of the current of heated air. This is ſubject to no rule, being changed according to the load on the jack. We imagine that an obliquity of 65 degrees for the outer ends of the vanes will be a good poſition for the generality of caſes. Meſſinger deſcribes an ingenious contrivance for changing this angle at pleaſure, in order to vary the velocity of the motion. Each vane is made to turn round a midrib, which ſtands out like a radius from the ſpindle, and the vane is moved by a ſtiff wire attached to one of the corners adjoining to the axle. Theſe wires are attached to a ring which ſlides on the ſpindle like the ſpreader of an umbrella; and it is ſtopped on any part of the ſpindle by a pin thruſt through a hole in the ſpindle and ring. We mention this briefly, it being eaſily underſtood by any mechanic, and but of little conſequence, becauſe the machine is not ſuſceptible of much preciſion.

It is eaſy to ſee that an increaſe of the ſurface of the vanes will increaſe the power: therefore they ſhould occupy the whole ſpace of the circle, and not conſiſt of four narrow arms like the ſails of a windmill. It is better to make many narrow vanes than a few broad ones; as will appear plain to one well acquainted with the mode of impulſe of fluids acting obliquely. We recommend 8 or 12 at leaſt; and each vane ſhould be ſo broad, that when the whole is held perpendicular between the eye and the light, no light ſhall come through the fly, the vanes overlapping each other *a very ſmall matter*. We alſo recommend the making them of ſtiff plate. Their weight contributes to the ſteady motion, and enables the fly, which has acquired a conſiderable velocity during a favourable poſition of things, to retain a momentum ſufficient to pull round the ſpit while the heavy ſide of the meat is riſing from its loweſt poſition. In ſuch a ſituation a light fly ſoon loſes its momentum, and the jack ſtaggers under its load.

It is plain, from what has been ſaid, that the fly ſhould occupy the whole of that ſection of the vent where it is placed. The vent muſt therefore be brought to a round form in that place, that none of the current may paſs uſeleſsly by it.

It is an important queſtion where the fly ſhould be placed. If in a wide part of the vent, it will have a great ſurface, and act by a long lever; but the current in that place is ſlow, and its impulſe weak. This is a fit ſubject of calculation. Suppoſe that we have it in our choice to place it either as it is drawn in the figure, or farther up at *g*, where its diameter muſt be one half of what it is at G. Since the ſame quantity of heated air paſſes through both ſections, and the ſection *g* has only one-

fourth

Smoke-Jack.

fourth of the area of the ſection G, it is plain that the air muſt be moving four times faſter, and that its impulſe is 16 times greater. But the ſurface on which it is acting is the fourth part of that of the fly G; the actual impulſe therefore is only four times greater, ſuppoſing both flies to be moving with the ſame relative velocity in reſpect of the current; that is, the rim of each moving with the ſame portion of the velocity of the current. This will be the caſe when the ſmall fly turns eight times as often in a minute as the large fly: for the air is moving four times as quick at *g*, and the diameter of *g* is one-half of that of G. Therefore, when the ſmall fly is turning eight times as quick as the great one, there is a quadruple impulſe acting at half the diſtance from the axis. The momentum or energy therefore of the current is double. Therefore, ſuppoſing the pinion, wheel, and pulleys of both jacks to be the ſame, the jack with the ſmall fly, placed in the narrow part of the vent, will be 16 times more powerful.

By this example, more eaſily underſtood than a general proceſs, it appears that it is of particular importance to place the fly in an elevated part of the vent, where the area may be much contracted. In order ſtill farther to increaſe the power of the machine, it would be very proper to lengthen the ſpindle ſtill more, and to put another fly on it at a conſiderable diſtance above the firſt, and a third above this, &c.

As the velocity of the current changes by every change of the fire, the motion of this jack muſt be very unſteady. To render it as adjuſtable as may be to the particular purpoſe of the cook, the pulley E has ſeveral grooves of different diameters, and the ſpit turns more or leſs ſlowly, by the ſame motion of the fly, according as it hangs in the chain by a larger or ſmaller pulley or groove.

Such is the conſtruction of the ſmoke-jack in its moſt ſimple form. Some are more artificial and complicated, having, in place of the pulleys and connecting chain, a ſpindle coming down from the horizontal axis BC. On the upper end of this ſpindle is a horizontal contrate wheel, driven by a pinion in place of the pulley C. On the lower end is a pinion, driving a contrate wheel in place of the pulley E. This conſtruction is repreſented in fig. 6. Others are conſtructed more ſimply, in the manner repreſented in fig. 7. But our firſt conſtruction has great advantage in point of ſimplicity, and allows a more eaſy adjuſtment of the ſpit, which may be brought nearer to the fire or removed farther from it without any trouble; whereas, in the others, with a train of wheels and pinions, this cannot be done without ſeveral changes of pins and ſcrews. The only imperfection of the pulley is, that by long uſe the grooves become ſlippery, and an ill balanced joint is apt to hold back the ſpit, while the chain ſlides in the grooves. This may be completely prevented by making the grooves flat inſtead of angular (which greatly diminiſhes the friction), and furniſhing them with ſhort ſtuds or pins which take into every third or fourth link of the chain. If the chain be made of the ſimpleſt form, with flat links, and each link be made of an exact length (making them all on a mould), the motion will be as eaſy as with any wheelwork, and without the leaſt chance of ſlipping.

Smoke-Jack.

It is always of importance to avoid this ſlipping of the chain by balancing the loaded ſpit. For this purpoſe it will be extremely convenient to have what is called a *balance-ſkewer*. Let a part of the ſpit, immediately adjoining to the pulley, be made round, and let an arm be made to turn on it ſtiffly, ſo that it may be made faſt in any poſition by a ſcrew. Let a leaden ball be made to ſlide along this arm, with a ſcrew to faſten it at any diſtance from the ſpit. When the meat is ſpitted, lay it on the racks, and the heavieſt ſide will immediately place itſelf undermoſt. Now turn round the balance-ſkewer, ſo that it may point ſtraight upwards, and make it faſt in that poſition by the ſcrew. Put the leaden ball on it, and ſlide it inwards or outwards till it exactly balances the heavy ſide, which will appear by the ſpit's remaining in any poſition in which it is put.

The greateſt difficulty is to keep the machine in repair. The moſt conſequential part of it, the firſt mover, the fly, and the pinion and wheel, by which its motion is tranſmitted to the reſt of the machine, are ſituated in a place of difficult acceſs, and where they are expoſed to violent heat and to the ſmoke and ſoot. The whole weight of the fly, reſting on the lower pivot I, muſt exert a great preſſure there, and occaſion great friction, even when this pinion is reduced to the ſmalleſt ſize that is compatible with the neceſſary ſtrength. The pivot muſt be of hardened ſteel, tapered like an obtuſe cone, and muſt turn in a conical ſocket, alſo of hardened ſteel or of bell-metal; and this ſeat of preſſure and friction muſt be continually ſupplied with oil, which it conſumes very quickly. It is not ſufficient that it be from time to time ſmeared with an oiled feather; there muſt be an iron cup formed round the ſocket, and kept filled with oil. It is ſurpriſing how quickly it diſappears: it ſoon becomes clammy by evaporation, and by the ſoot which gathers about it. The continued rubbing of the pivot and ſocket wears them both very faſt; and this is increaſed by hard powders, ſuch as ſandy duſt, that are hurried up by the rapid current every time that the cook ſtirs the fire. Theſe, getting between the rubbing parts, cauſe them to grind and wear each other prodigiouſly. It is a great improvement to invert theſe rubbing parts. Let the lower end of the ſpindle be of a conſiderable thickneſs, and have a conical hollow nicely drilled in its extremity. Let a blunt pointed conical pin riſe up in the middle of the oil-cup, on which the conical hollow of the ſpindle may reſt. Here will be the ſame ſteady ſupport, and the ſame friction as in the other way; but no grinding duſt can now lodge between the pivot and its ſocket: and if this upright pin be ſcrewed up through the bottom of the cup, it may be ſcrewed farther up in proportion as it wears; and thus the upper pivot *g* will never deſert its hole, a thing which ſoon happens in the common way. We can ſay from experience, that a jack conſtructed in this way will not require the fifth part of the repairs of one done in the other way.

It is of importance that the whole be ſo put together as to be eaſily taken down, in order to ſweep the vent, or to be repaired, &c. For this purpoſe, let the croſs bar which carries the lower end of the upright ſpindle be placed a little on one ſide of the perpendicular line from the upper pivot hole. Let the cock which

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carries the oil-cup and the pivot of the horizontal axis BC be ſcrewed to one ſide of this croſs bar, ſo that the centre of the cup may be exactly under the upper pivot hole. By this conſtruction we have only to unſcrew this cock, and then both axles come out of their places at once, and may be replaced without any trouble. We have ſketched in fig. 8. the manner in which this may be done, where M repreſents a ſection of the lower croſs bar. BCDE is the cock, fixed to the bar by the pins which go through both, with finger nuts *a* and *b* on the oppoſite ſide. F *i* is the hard ſteel pin with the conical top *i*, on which the lower end I of the upright ſpindle AG reſts, in the manner recommended as the beſt and the moſt durable. The pivot of the horizontal axis turns in a hole at E the top of the cock.

After all, we muſt acknowledge that the ſmoke jack is inferior to the common jack that is moved by a weight. It is more expenſive at firſt, and requires more frequent repairs; its motion is not ſo much under command; it occaſions ſoot to be thrown about the fire, to the great annoyance of the cook; and it is a great encumbrance when we would clean the vent.

Smoke-Farthings. The pentecoſtals or cuſtomary oblations offered by the diſperſed inhabitants within a dioceſe when they made their proceſſion to the mother or cathedral church, came by degrees into a ſtanding annual rent called *ſmoke-farthings*.

Smoke-Silver. Lands were holden in ſome places by the payment of the ſum of 6d. yearly to the ſheriff, called *ſmoke-ſilver* (Par. 4. Edw. VI.) Smoke-ſilver and ſmoke-penny are to be paid to the miniſters of divers pariſhes as a *modus* in lieu of tithe-wood: and in ſome manors formerly belonging to religious houſes, there is ſtill paid, as appendant to the ſaid manors, the ancient Peter-pence, by the name of *ſmoke-money* (*Twiſd. Hiſt. Vindicat.* 77.)—The biſhop of London *anno* 1444 iſſued out his commiſſion, *Ad levandum le* ſmoke-farthings, &c.

SMOLENSKO, a large and ſtrong city of Ruſſia, and capital of a palatinate of the ſame name, with a caſtle ſeated on a mountain, and a biſhop's ſee. It is ſtrong by its ſituation, being in the middle of a wood, and ſurrounded by almoſt inacceſſible mountains. It has been taken and retaken ſeveral times by the Poles and Ruſſians; but theſe laſt have had poſſeſſion of it ever ſince the year 1687. It is ſeated on the river Nieper, near the frontiers of Lithuania, 188 miles ſouth-weſt of Moſcow. E. Long. 31. 22. N. Lat. 54. 50.

SMOLENSKO, a duchy and palatinate of Ruſſia, bounded on the north by Biela, on the eaſt by the duchy of Moſcow, on the ſouth by that of Severia and the palatinate of Meiſlaw, and on the weſt by the ſame palatinate and by that of Witepſk. It is full of foreſts and mountains: and the capital is of the ſame name.

SMOLLET (Dr Tobias), an author whoſe writings will tranſmit his name with honour to poſterity, was born in the year 1720 at a ſmall village within two miles of Cameron, on the banks of the river Leven. He appears to have received a claſſical education, and was bred to the practice of phyſic and ſurgery; and in the early part of his life ſerved as a ſurgeon's mate in the navy.

The incidents that befel him during his continuance in this capacity ſerved as a foundation for Roderic Random, one of the moſt entertaining novels in the Engliſh tongue. He was preſent at the ſiege of Carthagena; and in the before-mentioned novel he has given a faithful, though not very pleaſing, account of the management of that ill-conducted expedition, which he cenſures in the warmeſt terms, and from circumſtances which fell under his own particular obſervation. Smollet.

His connection with the ſea ſeems not to have been of long continuance; and it is probable that he wrote ſeveral pieces before he became known to the public by his capital productions. The firſt piece we know of with certainty is a Satire in two parts, printed firſt in the years 1746 and 1747, and reprinted in a Collection of his Plays and Poems in 1777. About this period, or ſome time before, he wrote for Mr Rich an opera intitled Alceſte, which has never been performed nor printed.

At the age of 18 he wrote a tragedy intitled The Regicide, founded on the ſtory of the aſſaſſination of James I. of Scotland. In the preface to this piece, publiſhed by ſubſcription in the year 1749, he bitterly exclaimed againſt falſe patrons, and the duplicity of theatrical managers. The warmth and impetuoſity of his temper hurried him, on this occaſion, into unjuſt reflections againſt the late George Lord Lyttleton and Mr Garrick: the character of the former he characteriſed in the novel of Peregrine Pickle, and he added a burleſque of the Monody written by that nobleman on the death of his lady. Againſt Mr Garrick he made illiberal ill-founded criticiſms; and in his novel of Roderic Random gave a very unfair repreſentation of his treatment of him reſpecting this tragedy. Of this conduct he afterwards repented, and acknowledged his errors; though in the ſubſequent editions of the novel the paſſages which were the haſty effuſions of diſappointment are not omitted.

However, in giving a ſketch of the liberal arts in his Hiſtory of England, he afterwards remarked, "the exhibitions of the ſtage were improved to the moſt exquiſite entertainment by the talents and management of Garrick, who greatly ſurpaſſed all his predeceſſors of this and perhaps every other nation, in his genius for acting, in the ſweetneſs and variety of his tones, the irreſiſtible magic of his eye, the fire and vivacity of his action, the eloquence of attitude, and the whole pathos of expreſſion.

"Candidates for literary fame appeared even in the higher ſphere of life, embelliſhed by the nervous ſenſe and extenſive erudition of a Corke; by the delicate taſte, the poliſhed muſe, and the tender feelings, of a Lyttleton."

Not ſatisfied with this public declaration, he wrote an apology to Mr Garrick in ſtill ſtronger terms. With theſe ample conceſſions, Mr Garrick was completely ſatisfied; ſo that in 1757, when Dr Smollet's comedy of the Repriſals, an afterpiece of two acts, was performed at Drury-Lane theatre, the latter acknowledged himſelf highly obliged for the friendly care of Mr Garrick exerted in preparing it for the ſtage; and ſtill more for his acting the part of Luſignan in Zara for his benefit, on the ſixth inſtead of the ninth night, to which he was only intitled by the cuſtom of the theatre.

The Adventures of Roderic Random, publiſhed in 1748, 2 vols 12mo, a book which ſtill continues to have a moſt extenſive

Smollet.

extenſive ſale, firſt eſtabliſhed the Doctor's reputation. All the firſt volume and the beginning of the ſecond appears to conſiſt of real incident and character, tho' certainly a good deal heightened and diſguiſed. The Judge his grandfather, Crab and Potion the two apothecaries, and 'Squire Gawky, were characters well known in that part of the kingdom where the ſcene was laid. Captains Oakhum and Whiffle, Doctors Mackſhane and Morgan, were alſo ſaid to be real perſonages; but their names we have either never learned or have now forgotten. A bookbinder and barber long eagerly contended for being ſhadowed under the name of *Strap*. The Doctor ſeems to have enjoyed a peculiar felicity in deſcribing ſea-characters, particularly the officers and ſailors of the navy. His Trunnion, Hatchway, and Pipes, are highly finiſhed originals; but what exceeds them all, and perhaps equals any character that has yet been painted by the happieſt genius of ancient or modern times, is his Lieutenant Bowling. This is indeed nature itſelf; original, *unique*, and *ſui generis*.

By the publication of this work the Doctor had acquired ſo great a reputation, that henceforth a certain degree of ſucceſs was inſured to every thing known or ſuſpected to proceed from his hand. In the courſe of a few years, the Adventures of Peregrine Pickle appeared; a work of great ingenuity and contrivance in the compoſition, and in which an uncommon degree of erudition is diſplayed, particularly in the deſcription of the entertainment given by the Republican Doctor, after the manner of the ancients. Under this perſonage the late Dr Akenſide, author of The Pleaſures of Imagination, is ſuppoſed to be typified; and it would be difficult to determine whether profound learning or genuine humour predominate moſt in this epiſode. Another epiſode of The Adventures of a Lady of Quality, likewiſe inſerted in this work, contributed greatly to its ſucceſs, and is indeed admirably executed; the materials, it is ſaid, the lady herſelf (the celebrated lady *Vane*) furniſhed.

Theſe were not the only original compoſitions of this ſtamp with which the Doctor has favoured the public. Ferdinand Count Fathom, and Sir Launcelot Greaves, are ſtill in the liſt of what may be called *reading novels*, and have gone through ſeveral editions; but there is no injuſtice in placing them in a rank far below the former. No doubt invention, character, compoſition, and contrivance, are to be found in both; but then ſituations are deſcribed which are hardly poſſible, and characters are painted which, if not altogether unexampled, are at leaſt incompatible with modern manners; and which ought not to be, as the ſcenes are laid in modern times.

The laſt work which we believe the Doctor publiſhed was of much the ſame ſpecies, but caſt into a different form—The Expedition of Humphrey Clinker. It conſiſts of a ſeries of letters, written by different perſons to their reſpective correſpondents. He has here carefully avoided the faults which may be juſtly charged to his two former productions. Here are no extravagant characters nor unnatural ſituations. On the contrary, an admirable knowledge of life and manners is diſplayed; and moſt uſeful leſſons are given applicable to intereſting but to very common ſituations.

We know not whether the remark has been made, but there is certainly a very obvious ſimilitude between the characters of the three heroes of the Doctor's chief productions. Roderic Random, Peregrine Pickle, and Matthew Bramble, are all brothers of the ſame family. The ſame ſatirical, cynical, diſpoſition, the ſame generoſity and benevolence, are the diſtinguiſhing and characteriſtical features of all three; but they are far from being ſervile copies or imitations of each other. They differ as much as the Ajax, Diomed, and Achilles of Homer. This was undoubtedly a great effort of genius; and the Doctor ſeems to have deſcribed his own character at the different ſtages and ſituations of his life.

Smollet.

Before he took a houſe at Chelſea, he attempted to ſettle as practitioner of phyſic at Bath; and with that view wrote a treatiſe on the waters; but was unſucceſsful, chiefly becauſe he could not render himſelf agreeable to the women, whoſe favour is certainly of great conſequence to all candidates for eminence, whether in medicine or divinity. This, however, was a little extraordinary; for thoſe who remembered Dr Smollet at that time, cannot but acknowledge that he was as graceful and handſome a man as any of the age he lived in; beſides, there was a certain dignity in his air and manner which could not but inſpire reſpect wherever he appeared. Perhaps he was too ſoon diſcouraged; in all probability, had he perſevered, a man of his great learning, profound ſagacity, and intenſe application, beſides being endued with every other external as well as internal accompliſhment, muſt have at laſt ſucceeded, and, had he attained to common old age, been at the head of his profeſſion.

Abandoning phyſic altogether as a profeſſion, he fixed his reſidence at Chelſea, and turned his thoughts entirely to writing. Yet, as an author, he was not near ſo ſucceſsful as his happy genius and acknowledged merit certainly deſerved. He never acquired a patron among the great, who by his favour or beneficence relieved him from the neceſſity of writing for a ſubſiſtence. The truth is, Dr Smollet poſſeſſed a loftineſs and elevation of ſentiment and character which appears to have diſqualified him for paying court to thoſe who were capable of conferring favours. It would be wrong to call this diſpoſition pride or haughineſs; for to his equals and inferiors he was ever polite, friendly, and generous. Bookſellers may therefore be ſaid to have been his only patrons; and from them he had conſtant employment in tranſlating, compiling, and reviewing. He tranſlated Gil Blas and Don Quixote, both ſo happily, that all the former tranſlations of theſe excellent productions of genius have been almoſt ſuperſeded by his. His name likewiſe appears to a tranſlation of Voltaire's Proſe Works: but little of it was done by his own hand; he only reviſed it, and added a few notes. He was concerned in a great variety of compilations. His Hiſtory of England was the principal work of that kind. It had a moſt extenſive ſale; and the Doctor is ſaid to have received L. 2000 for writing it and the continuation.

In 1755 he ſet on foot the Critical Review, and continued the principal manager of it till he went abroad for the firſt time in the year 1763. He was perhaps too acrimonious ſometimes in the conduct of that work; and at the ſame time diſplayed too much ſenſibility when

Smollet. when any of the unfortunate authors attempted to retaliate whoſe works he had perhaps juſtly cenſured.

Among other controverſies in which his engagements in this publication involved him, the moſt material in its conſequences was that occaſioned by his remarks on a pamphlet publiſhed by Admiral Knowles. That gentleman, in defence of his conduct on the expedition to Rochfort, publiſhed a vindication of himſelf; which falling under the Doctor's examination, produced ſome very ſevere ſtrictures both on the performance and on the character of the writer. The admiral immediately commenced a proſecution againſt the printer; declaring at the ſame time that he deſired only to be informed who the writer was, that if he proved to be a gentleman he might obtain the ſatisfaction of one from him. In this affair the Doctor behaved both with prudence and with ſpirit. Deſirous of compromiſing the diſpute with the admiral in an amicable manner, he applied to his friend Mr Wilkes to interpoſe his good offices with his opponent. The admiral, however, was inflexible; and juſt as ſentence was going to be pronounced againſt the printer, the Doctor came into court, avowed himſelf the author of the Strictures, and declared himſelf ready to give Mr Knowles any ſatisfaction he choſe. The admiral immediately commenced a freſh action againſt the Doctor, who was found guilty, fined L.100, and condemned to three months impriſonment in the King's Bench. It is there he is ſaid to have written The Adventures of Sir Launcelot Greaves, in which he has deſcribed ſome remarkable characters, then his fellow-priſoners.

When Lord Bute was called to the chief adminiſtration of affairs, he was prevailed upon to write in defence of that nobleman's meaſures; which he did in a weekly paper called the *Briton*. This gave riſe to the famous North Briton; wherein, according to the opinion of the public, he was rather baffled. The truth is, the Doctor did not ſeem to poſſeſs the talents neceſſary for political altercation. He wanted temper and coolneſs; and his friends accuſed his patron of having denied him the neceſſary information, and even neglected the fulfilling of ſome of his other engagements with him. Be that as it will, the Doctor is ſaid not to have forgotten him in his ſubſequent performances.

Beſides the Briton, Dr Smollet is ſuppoſed to have written other pieces in ſupport of the cauſe he eſpouſed. The Adventures of an Atom, in two volumes, are known to be his production.

His conſtitution being at laſt greatly impaired by a ſedentary life and aſſiduous application to ſtudy, he went abroad for his health in June 1763, and continued in France and Italy two years. He wrote an account of his travels in a ſeries of letters to ſome friends, which were afterwards publiſhed in two volumes octavo, 1766. During all that time he appears to have laboured under a conſtant fit of chagrin. A very ſlight peruſal of theſe letters will ſufficiently evince that this obſervation is founded in fact, and is indeed a melancholy inſtance of the influence of bodily diſtemper over the beſt diſpoſition.

His relation of his travels is actually cynical; for which Sterne, in his Sentimental Journey, has animadverted on him under the character of Smelfungus. The Doctor lived to return to his native country: but his health continuing to decline, and meeting with freſh mortifications and diſappointments, he went back to Italy, where he died in October 21. 1771. He was employed, during the laſt years of his life, in abridging the Modern Univerſal Hiſtory, great part of which he had originally written himſelf, particularly the hiſtories of France, Italy, and Germany. Smollet, Smugglers.

He certainly met with many mortifications and diſappointments; which, in a letter to Mr Garrick, he thus feelingly expreſſes: "I am old enough to have ſeen and obſerved, that we are all playthings of Fortune; and that it depends upon ſomething as inſignificant and precarious as the toſſing up of a halfpenny, whether a man riſes to affluence and honours, or continues to his dying day ſtruggling with the difficulties and diſgraces of life."

It would be needleſs to expatiate on the character of a man ſo well known as Dr Smollet, who has, beſides, given ſo many ſtrictures of his own character and manner of living in his writings, particularly in Humphrey Clinker; where he appears under the appellation of *Mr Serle*, and has an interview with Mr Bramble; and his manner of living is deſcribed in another letter, where young Melford is ſuppoſed to dine with him at his houſe in Chelſea. No doubt he made money by his connections with the bookſellers; and had he been a rigid economiſt, or endued with the gift of retention (an expreſſion of his own), he might have lived and died very independent. However, to do juſtice to his memory, his difficulties, whatever they were, proceeded not from extravagance or want of economy. He was hoſpitable, but not oſtentatiouſly ſo; and his table was plentiful, but not extravagant. No doubt he had his failings; but ſtill it would be difficult to name a man who was ſo reſpectable for the qualities of his head, or more amiable for the virtues of his heart.

Since his death a monument has been erected to his memory near Leghorn, on which is inſcribed an epitaph written in Latin by his friend Dr Armſtrong, author of The Art of Preſerving Health, and many other excellent pieces. An inſcription written in Latin was likewiſe inſcribed on a pillar erected to his memory on the banks of the Leven, by one of his relations.

To theſe memoirs we are extremely ſorry to add, that ſo late as 1785 the widow of Dr Smollet was reſiding in indigent circumſtances at Leghorn. On this account the tragedy of Venice Preſerved was acted for her benefit at Edinburgh on the 5th of March, and an excellent prologue ſpoken on that occaſion.

The pieces inſerted in the poſthumous collection of Dr Smollet's plays and poems are, The Regicide, a tragedy: The Repriſal, a comedy; Advice and Reproof, two ſatires; The Tears of Scotland; Verſes on a Young Lady; a Love Elegy, in imitation of Tibullus; two Songs; a Burleſque Ode; Odes to Mirth, to Sleep, to Leven Water, to Blue-ey'd Ann, and to Independence.

SMUGGLERS, perſons who import or export prohibited goods without paying the duties appointed by the law.

The duties of cuſtoms, it is ſaid, were originally inſtituted, in order to enable the king to afford protection to trade againſt pirates: they have ſince been continued as a branch of the public revenue. As duties

im-

Smugglers.

imposed upon the importation of goods necessarily raises their price above what they might otherwise have been sold for, a temptation is presented to import the commodity clandestinely and to evade the duty. Many persons, prompted by the hopes of gain, and considering the violation of a positive law of this nature as in no respect criminal (an idea in which they have been encouraged by a great part of the community, who make no scruple to purchase smuggled goods), have engaged in this illicit trade. It was impossible that government could permit this practice, which is highly injurious to the fair trader, as the smuggler is enabled to undersell him, while at the same time he impairs the national revenue, and thus wholly destroys the end for which these duties were appointed. Such penalties are therefore inflicted as it was thought would prevent smuggling.

Burn's Law Dictionary, vol. ii.

Many laws have been made with this view. If any goods be shipped or landed without warrant and presence of an officer, the vessel shall be forfeited, and the wharfinger shall forfeit L. 100, and the master or mariner of any ship inward bound shall forfeit the value of the goods: and any carman, porter, or other assisting, shall be committed to gaol, till he find surety of the good behaviour, or until he shall be discharged by the court of exchequer (13 & 14 C. II. c. 11.) If goods be relanded after drawback, the vessel and goods shall be forfeited; and every person concerned therein shall forfeit double the value of the drawback (8 An. c. 13.) Goods taken in at sea shall be forfeited, and also the vessel into which they are taken; and every person concerned therein shall forfeit treble value (9 G. II. c. 35.) A vessel hovering near the coast shall be forfeited, if under 50 tons burden; and the goods shall also be forfeited, or the value thereof (5 G. III. c. 43.) Persons receiving or buying run goods shall forfeit L. 20 (8 G. c. 18.) A concealer of run goods shall forfeit treble value (8 G. c. 18.) Offering run goods to sale, the same shall be forfeited, and the person to whom they are offered may seize them; and the person offering them to sale shall forfeit treble value (11 G. c. 30.) A porter or other person carrying run goods shall forfeit treble value (9 G. II. c. 35.) Persons armed or disguised carrying run goods shall be guilty of felony, and transported for seven years (8 G. c. 18. 9 G. II. c. 35.)

But the last statute, 19 G. II. c. 34. is for this purpose *instar omnium*; for it makes all forcible acts of smuggling, carried on in defiance of the laws, or even in disguise to evade them, felony without benefit of clergy: enacting, that if three or more persons shall assemble, with fire-arms or other offensive weapons, to assist in the illegal exportation or importation of goods, or in rescuing the same after seizure, or in rescuing offenders in custody for such offences; or shall pass with such goods in disguise; or shall wound, shoot at, or assault, any officers of the revenue when in the execution of their duty; such persons shall be felons, without the benefit of clergy.

When we consider the nature, and still more the history, of mankind, we must allow that the enacting of severe penal laws is not the way to prevent crimes. It were indeed much to be wished that there were no such thing as a political crime; for the generality of men, but especially the lower orders, not discerning the propriety or utility of such laws, consider them as oppressive and tyrannical, and never hesitate to violate them when they can do it with impunity. Instead therefore of punishing smugglers, it would be much better to remove the temptation. But the high duties which have been imposed upon the importation of many different sorts of foreign goods, in order to discourage their consumption in Great Britain, have in many cases served only to encourage smuggling; and in all cases have reduced the revenue of the customs below what more moderate duties would have afforded. The saying of Dr Swift, that in the arithmetic of the customs two and two, instead of making four, make sometimes only one, holds perfectly true with regard to such heavy duties, which never could have been imposed, had not the mercantile system taught us, in many cases, to employ taxation as an instrument, not of revenue, but of monopoly.

Smugglers || Smyrna.

Smith's Wealth of Nations, vol. iii.

The bounties which are sometimes given upon the exportation of home produce and manufactures, and the drawbacks which are paid upon the re-exportation of the greater part of foreign goods, have given occasion to many frauds, and to a species of smuggling more destructive of the public revenue than any other. In order to obtain the bounty or drawback, the goods, it is well known, are sometimes shipped and sent to sea, but soon afterwards clandestinely relanded in some other part of the country.

Heavy duties being imposed upon almost all goods imported, our merchant importers smuggle as much, and make entry of as little as they can. Our merchant-exporters, on the contrary, make entry of more than they export; sometimes out of vanity, and to pass for great dealers in goods which pay no duty; and sometimes to gain a bounty or a drawback. Our exports, in consequence of these different frauds, appear upon the customhouse books greatly to overbalance our imports; to the unspeakable comfort of those politicians who measure the national prosperity by what they call the balance of trade.

SMUT, in husbandry, a disease in corn, when the grains, instead of being filled with flour, are full of a stinking black powder. See WHEAT.

SMYRNA, or ISMIR, at present the largest and richest city of Asia Minor, is situated in north latitude 38° 28′, and in E. Long. 27° 25′ from Greenwich, and about 183 miles west by south of Constantinople. The town extends along the shore about half a mile on a gentle declivity. The houses of the English, French, and Dutch consuls are handsome structures; these, with most of those occupied by the Christian merchants, are washed on one side by the sea, forming a street named *Frank-street*, from its being solely inhabited by European Christians. In the year 1763 the whole of this quarter was consumed by fire: the loss sustained by this calamity in merchandise was estimated at a million and a half of Turkish dollars, or near L. 200,000 Sterling. The port is one of the finest of the Levant, it being able to contain the largest fleet; and indeed there are seldom in it fewer than 100 ships of different nations.

A castle stands at its entrance, and commands all the shipping which sail in or out. There is likewise an old ruinous castle, near a mile in circumference, which stands in the upper part of the city, and, according to tradition,

Payne's Geography.

Smyrna. tion, was built by the empreſs Helena: and near it is an ancient ſtructure, ſaid to be the remains of a palace where the Greek council was held when Smyrna was the metropolis of Aſia Minor. They alſo ſhow the ruins of an amphitheatre, where it is ſaid St Polycarp, the firſt biſhop, fought with lions.

This city is about four miles in circumference, and nearly of a triangular form; but the ſide next the mountain is much longer than the other ſides. The houſes are low, and moſtly built with clay-walls, on account of the earthquakes to which the country is ſubject; but the caravanſeras and ſome other of the public buildings have an air of magnificence. The ſtreets are wide, and almoſt a continued bazar, in which a great part of the merchandize of Europe and Aſia is expoſed to ſale, with plenty of proviſions; though theſe are not ſo cheap as in many other parts of Turkey, on account of the populouſneſs of the place, and the great reſort of foreigners. It is ſaid to contain 15,000 Turks, 10,000 Greeks, 1800 Jews, 200 Armenians, and 200 Franks. The Turks have 19 moſques; two churches belong to the Greeks; one to the Armenians; and the Jews have eight ſynagogues. The Romaniſts have three convents. There is alſo one of the fathers Della Terra Santa. Here reſides an archbiſhop of the Greek church; a Latin biſhop who has a ſalary from Rome, with the title of biſhop of Smyrna *in partibus infidelium*; and the Engliſh and Dutch factories have each their chaplain.

The walks about the town are extremely pleaſant, particularly on the weſt ſide of Frank ſtreet, where there are ſeveral little groves of orange and lemon trees, which being always clothed with leaves, bloſſoms, and fruit, regale ſeveral of the ſenſes at the ſame time. The vines which cover the little hills about Smyrna afford both a delightful proſpect and plenty of grapes, of which good wine is made. Theſe hills are agreeably interſperſed with fertile plains, little foreſts of olives and other fruit-trees, and many pleaſure-houſes, to which the Franks uſually retire during the ſummer. In the neighbourhood of Smyrna is great plenty of game and wild-fowl, and particularly deer and wild-hogs. The ſea alſo abounds with a variety of good fiſh. The European Chriſtians are here allowed all imaginable liberties, and uſually clothe themſelves after the European manner.

The chief commerce of this city conſiſts in raw ſilk, ſilk-ſtuffs, grograms, and cotton yarn.

However, the unhealthfulneſs of the ſituation, and more eſpecially the frequent earthquakes, from which, it is ſaid, they are ſcarcely ever free for two years together, and which have been felt 40 days ſucceſſively, are an abatement of the pleaſure that might otherwiſe be enjoyed here. A very dreadful one happened in June 1688, which overthrew a great number of the houſes; and the rock opening where the caſtle ſtood, ſwallowed it up, and no leſs than 5000 perſons periſhed on this occaſion.

In the year 1758, ſo deſolating a plague raged here, that ſcarcely a ſufficient number of the inhabitants ſurvived to gather in the fruits of the earth. In the year 1772, three-fourth parts of the city were conſumed by fire; and ſix years after it was viſited by the moſt dreadful earthquakes, which continued from the 25th of June to the 5th of July; by which ſucceſſive calamities the city has been ſo much reduced, that its former conſequence is never likely to be reſtored. Smyrnium ‖ Snake.

The ladies here wear the oriental dreſs, conſiſting of large trowſers or breeches, which reach to the ancle; long veſts of rich ſilk or velvet, lined in winter with coſtly furs; and round their waiſt an embroidered zone with claſps of ſilver or gold. Their hair is plaited, and deſcends down the back often in great profuſion. The girls have ſometimes above twenty thick treſſes, beſides two or three encircling the head as a coronet, and ſet off with flowers and plumes of feathers, pearls, or other jewels. They commonly ſtain it of a cheſnut colour, which is the moſt deſired. Their apparel and carriage are alike antique. It is remarkable that the trowſers are mentioned in a fragment of Sappho as part of the female dreſs.

SMYRNIUM, ALEXANDERS: A genus of plants belonging to the claſs of *pentandria*, and to the order of *digynia*; and in the natural ſyſtem ranging under the 45th order, *Umbellatæ*. The fruit is oblong and ſtriated; the petals have a ſharp point, and are keel-ſhaped. There are five ſpecies: 1. The *perfoliatum*, or perfoliate alexanders, which is a native of Candia and Italy; 2. The *Ægyptiacum*; 3. The *aureum*, or golden alexanders, which is a native of North America; 4. The *integerrimum*; 5. The *oluſatrum*, common alexanders, a native of Britain; the leaves of which are cauline, ternate, petiolated, and ſerrated. It grows on the ſea-coaſt at Dunglas on the borders of Berwickſhire North Britain. Since the introduction of celery into the garden, the alexanders is almoſt forgotton. It was formerly cultivated for ſalading, and the young ſhoots or ſtalks blanched were eaten either raw or ſtewed. The leaves too were boiled in broths and ſoups. It is a warm comfortable plant to a cold weak ſtomach, and was in much eſteem among the monks, as may be inferred by its ſtill being found in great plenty by old abbey walls.

SNAFFLE, in the manege, is a very ſlender bit-mouth without any branches, much uſed in England; the true bridles being reſerved for war.

SNAIL, in zoology. See HELIX and LIMAX.

SNAKE, in zoology. See ANGUIS and SERPENS.

Method of Preſerving SNAKES. When the ſnake is killed, it muſt firſt be waſhed clean, and freed from all filth and naſtineſs; then it is to be put into a glaſs of a proper ſize, the tail firſt, and afterwards the reſt of the body, winding it in ſpiral aſcending circles, and diſpoſing the back, which is alway the moſt beautiful, outwardly. A thread, connected with a ſmall glaſs bead, is, by the help of a needle, to be paſſed through the upper jaw from within outwardly, and then through the cork of the bottle, where it muſt be faſtened; by this means the head will be drawn into a natural poſture, and the mouth kept open by the bead, whereby the teeth, &c. will be diſcovered: the glaſs is then to be filled with rum, and the cork ſealed down to prevent its exhalation. A label, containing the name and properties of the ſnake, is then to be affixed to the wax over the cork; and in this manner the ſnake will make a beautiful appearance, and may be preſerved a great number of years; nor will the ſpirits impair or change the luſtre of its colours.

SMOKE.

Fig. 4.

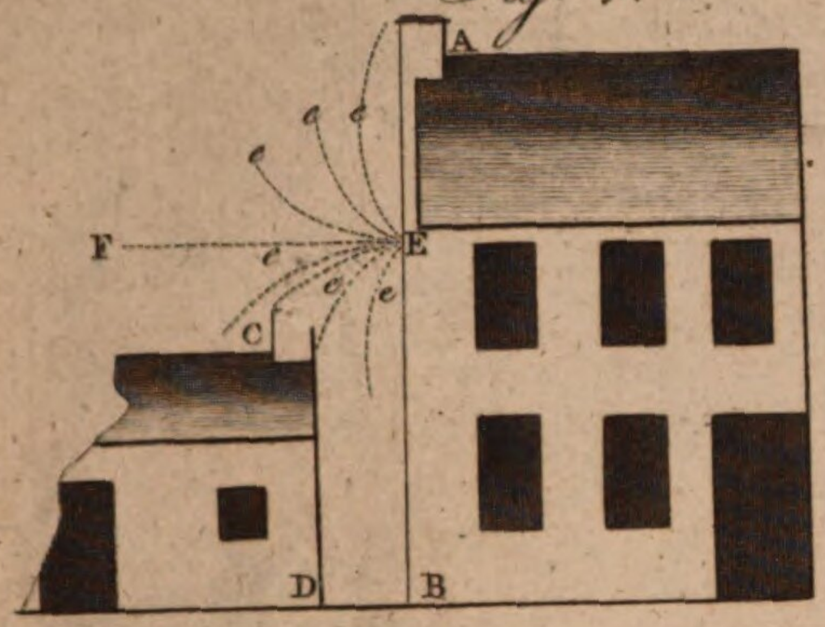


Fig. 1.

Fig. 2.

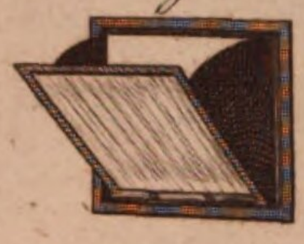


Fig. 3.

SMOKE JACK.

Fig. 8.

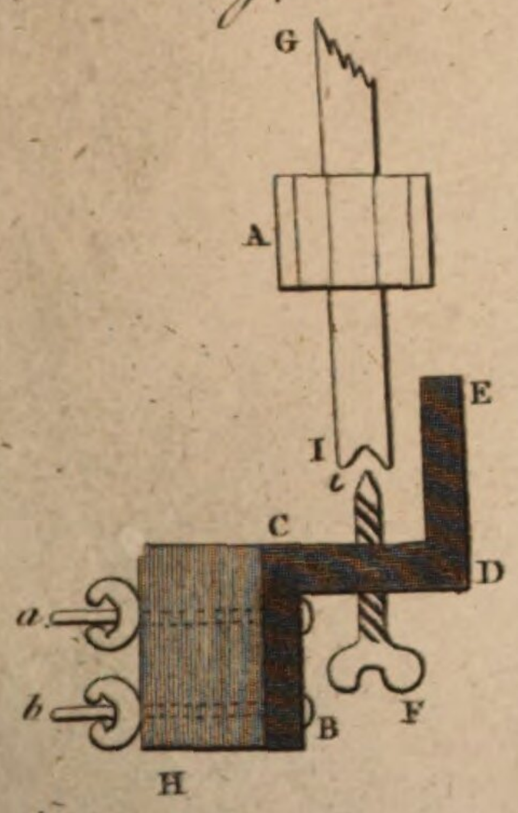
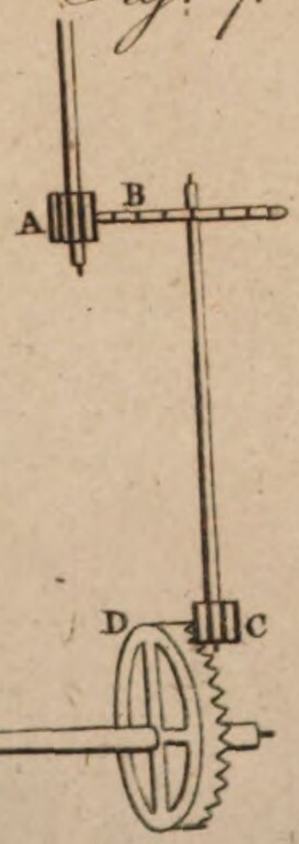


Fig. 7.



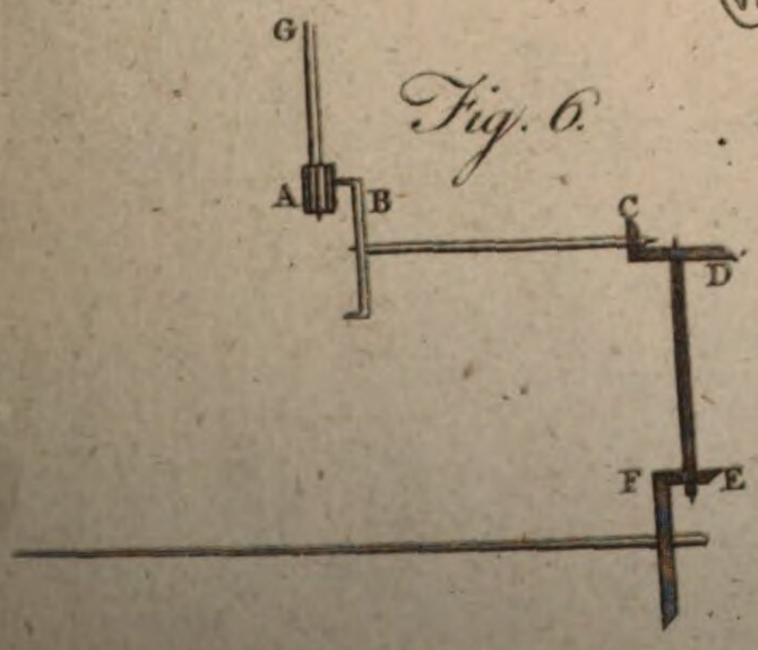
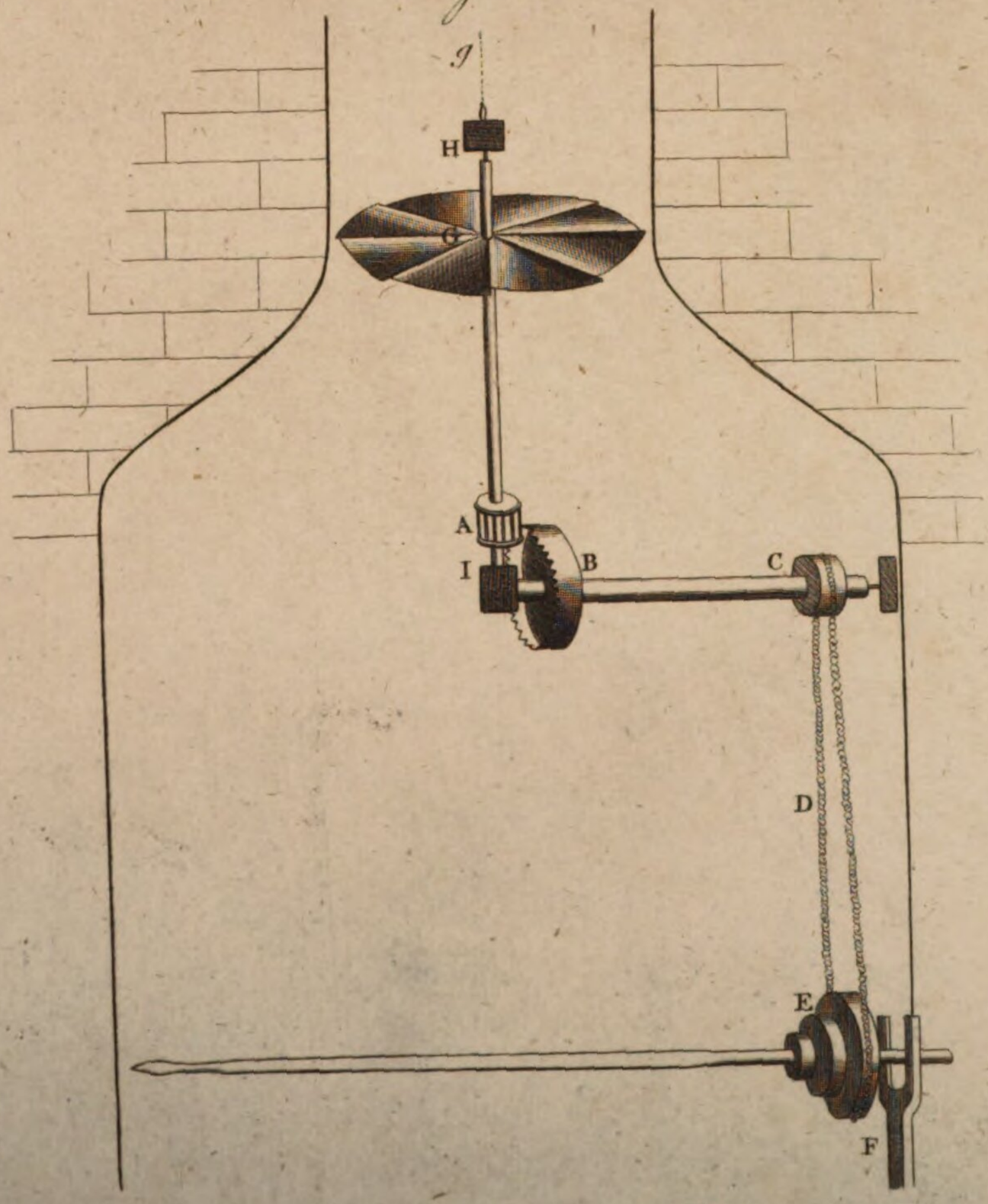


Fig. 6.

Fig. 5.



A. Bell Prin. Wal. Sculptor fecit

Specific Gravity.

Fig. 1.

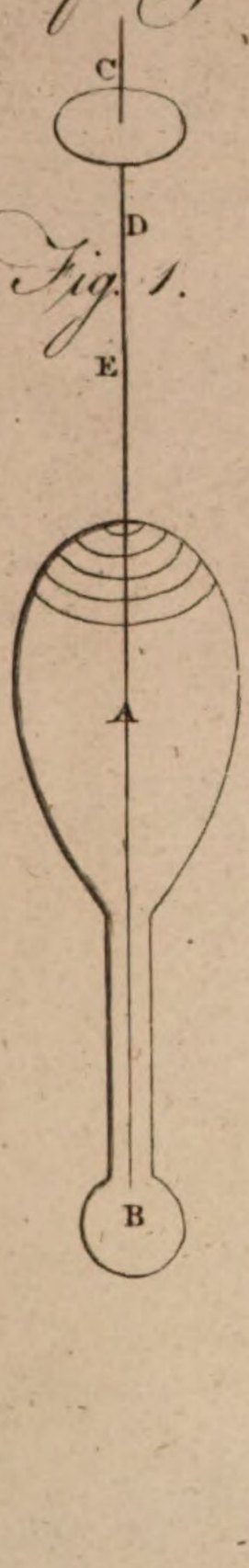
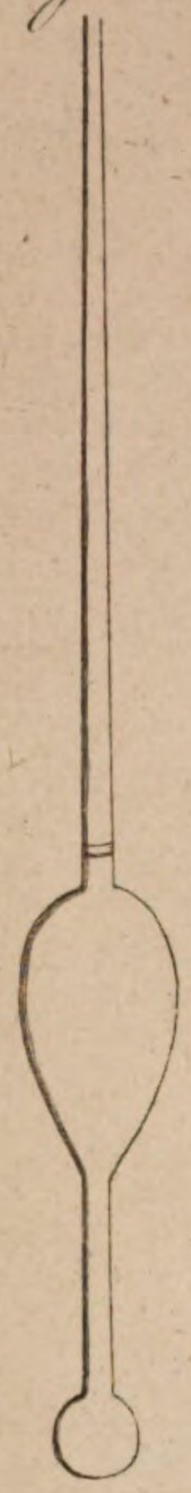
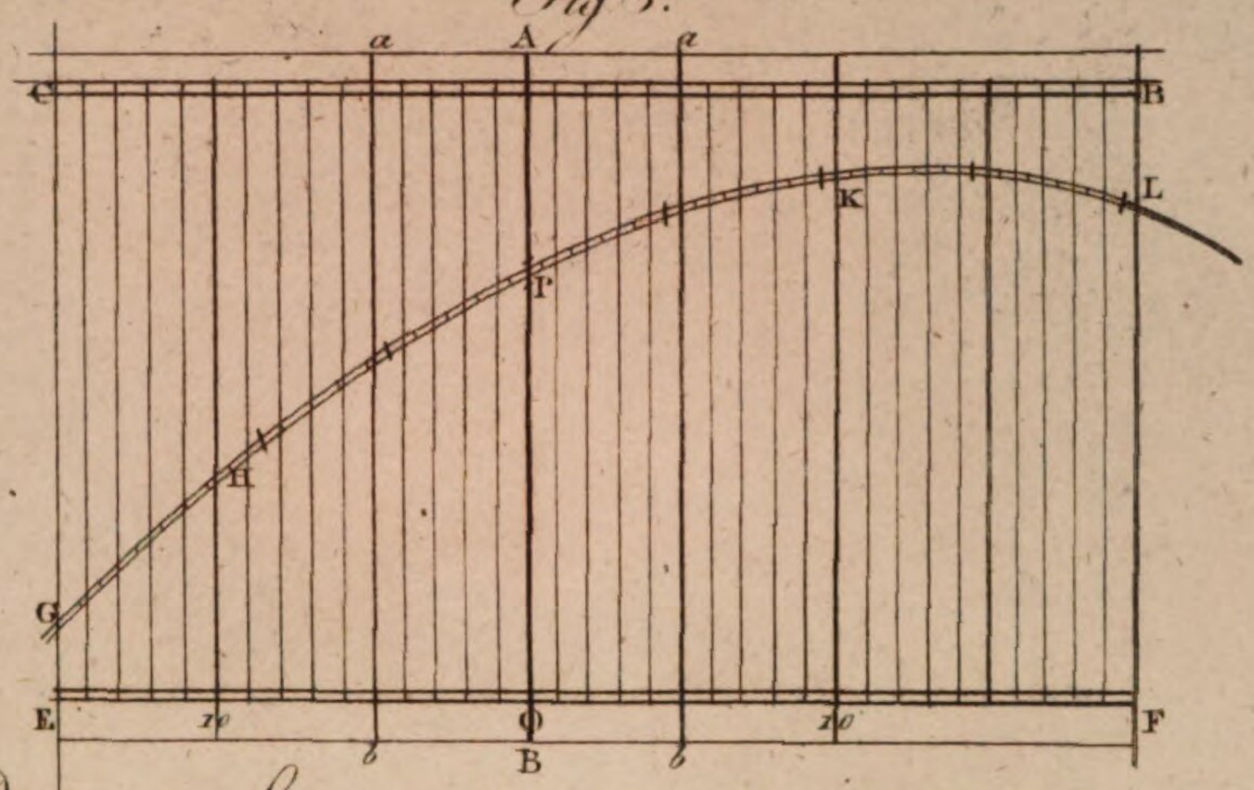


Fig. 2.



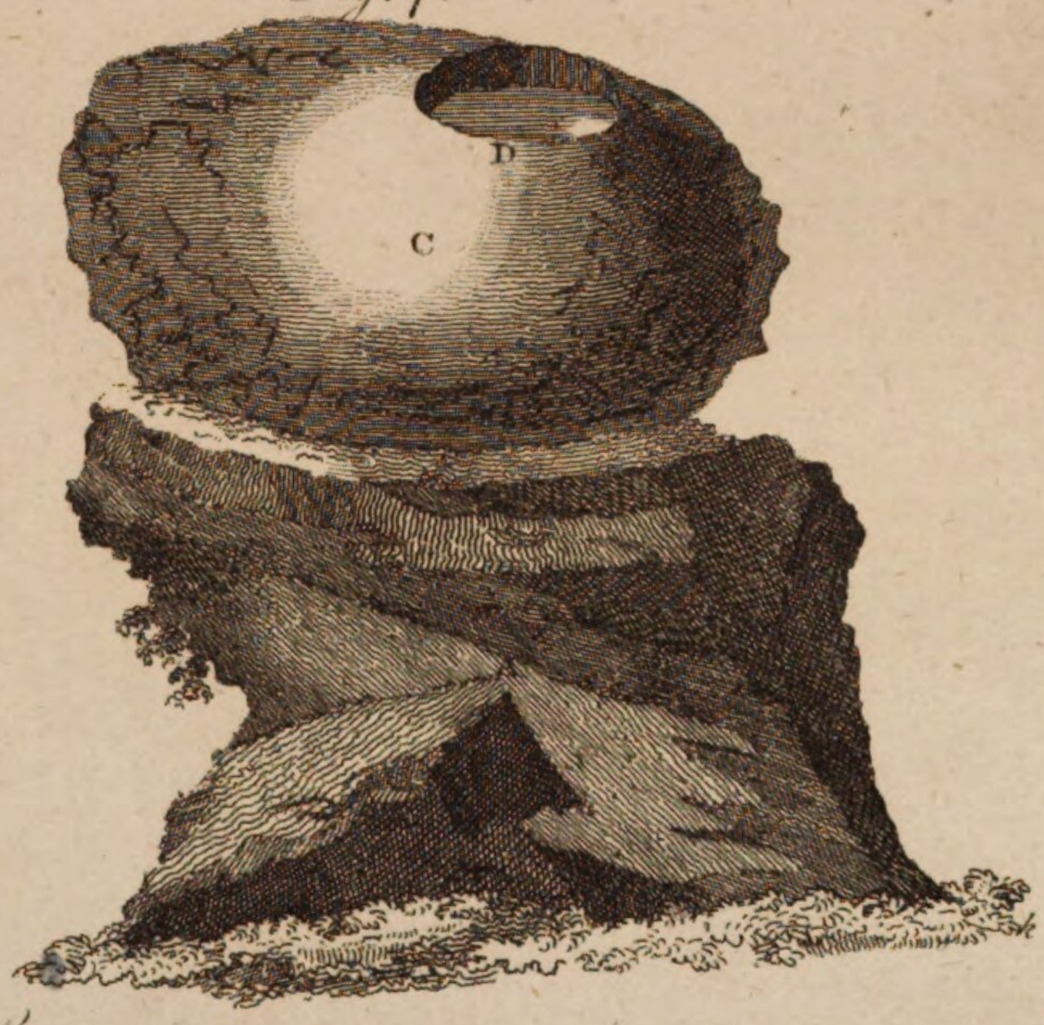
Spirituous Liquors.

Fig 3.



Rocking Stone.

Fig. 7.



Steam Kitchen.

Fig. 5.

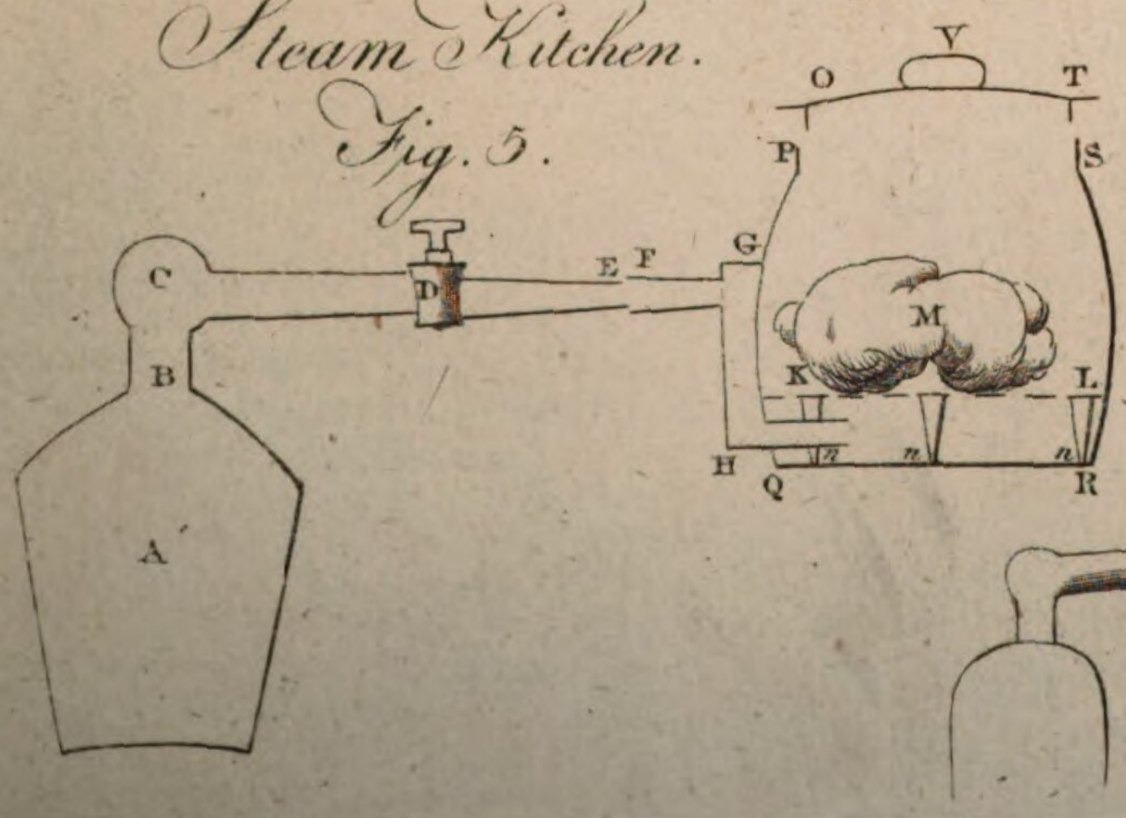


Fig. 4.

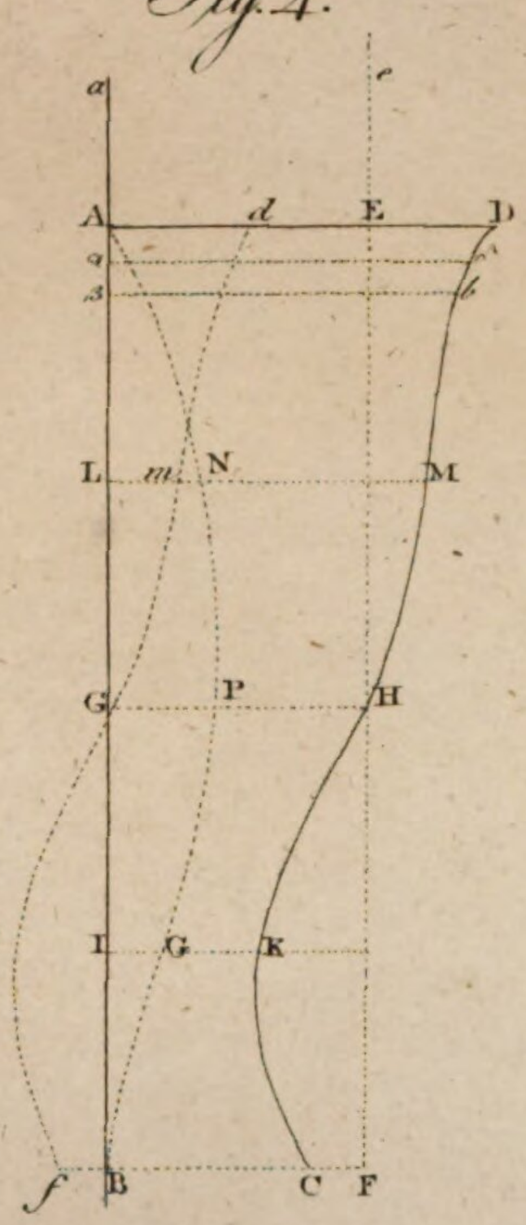
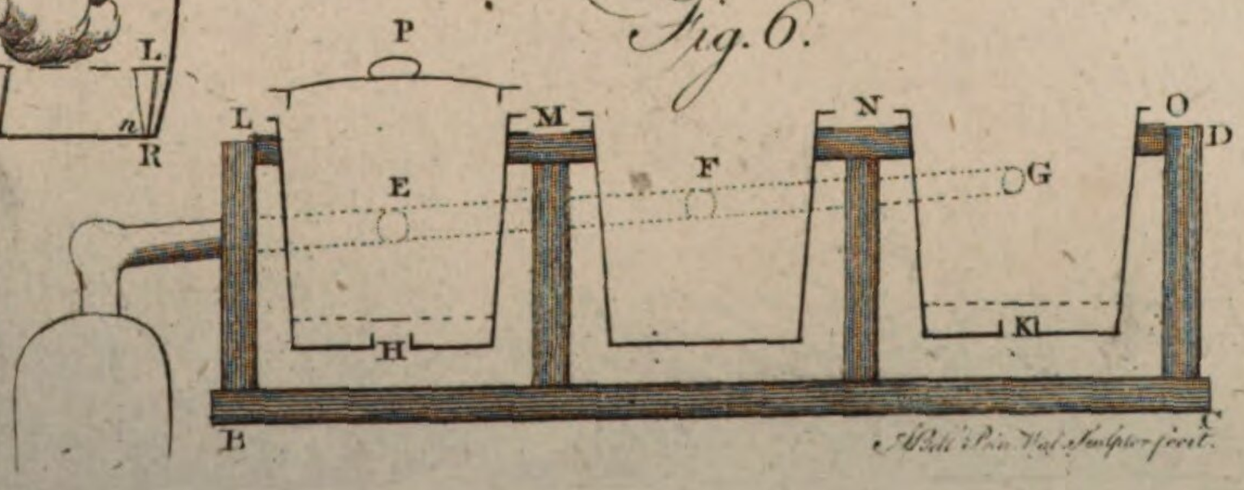


Fig. 6.



J. Bell's Pict. Vol. Sculptor fecit.

Snake-Stones.

Snake-Stones, *Ammonitæ*, in natural hiſtory, the name of a large genus of foſſil ſhells, very few if any of which are yet known in their recent ſtate, or living either on our own or any other ſhores; ſo that it ſeems wonderful whence ſo vaſt a number and variety of them ſhould be brought into our ſubterranean regions. They ſeem indeed diſperſed in great plenty throughout the world, but nowhere are found in greater numbers, beauty, and variety, than in our iſland.

Mr Harenberg found prodigious numbers of them on the banks of a river in Germany. He traced this river through its ſeveral windings for many miles, and among a great variety of belemnitæ, cornua ammonis, and cochlitæ, of various kinds; he found alſo great quantities of wood of recent petrifaction, which ſtill preſerved plain marks of the axe by which it had been cut from the trees then growing on the ſhore. The water of this river he found in dry ſeaſons, when its natural ſprings were not diluted with rains, to be conſiderably heavier than common water; and many experiments ſhowed him that it contained ferruginous, as well as ſtony particles, in great quantity, whence the petrifactions in it appeared the leſs wonderful, though many of them of recent date.

Of the cornua ammonis, or ſerpent-ſtones, he there obſerved more than 30 different ſpecies. They lie immerſed in a bluiſh foſſil ſtone, of a ſoft texture and fatty appearance, in prodigious numbers, and of a great variety of ſizes, from the larger known ſorts down to ſuch as could not be ſeen without very accurate inſpection or the aſſiſtance of a microſcope. Such as lie in the ſofteſt of theſe ſtones are ſoft like their matrix, and eaſily crumble to pieces; others are harder. In a piece of this ſtone, of the bigneſs of a finger, it is common to find 30 or more of theſe foſſils; and often they are ſeen only in form of white ſpecks, ſo minute that their figure cannot be diſtinguiſhed till examined by the microſcope.

They all conſiſt of ſeveral volutæ, which are different in number in the different ſpecies, and their ſtriæ alſo are extremely various; ſome very deep with very high ridges between them, others very ſlight; ſome ſtraight, others crooked; others undulated, and ſome terminating in dots, tubercles, or cavities, towards the back, and others having tubercles in two or three places. They are all compoſed of a great number of chambers or cells, in the manner of the *nautilus Græcorum*, each having a communication with the others, by means of a pipe or ſiphunculus. There is a ſmall white ſhell-fiſh of Barbadoes, which ſeems truly a recent animal of this genus; and in the Eaſt Indies there is another alſo, ſmall and greyiſh; but the large and beautifully marked ones are found only foſſil.

They are compoſed of various foſſil bodies, often of quarry ſtone, ſometimes of the matter of the common pyrites, and of a great variety of other ſubſtances; and though they appear uſually mere ſtones, yet in ſome the pearly part of the original ſhell is preſerved in all its beauty. Sometimes alſo, while the outer ſubſtance is of the matter of the pyrites, or other coarſe, ſtony, or mineral matter, the inner cavity is filled with a pure white ſpar of the common plated texture. This gives a great beauty to the ſpecimen. The cornua ammonis, or ſnake-ſtones, are found in many parts of England, particularly in Yorkſhire, where they are very plentiful in the alum rocks of ſeveral ſizes.

Snake-Root, in botany. See POLYGALA.

Snake-Weed, in botany. See POLYGONUM.

Snake-Root || Sneezing.

SNAPEDRAGON, in botany. See ANTIRRHINUM.

SNEEZING, a convulſive motion of the muſcles of the breaſt, whereby the air is expelled from the noſe with much vehemence and noiſe. It is cauſed by the irritation of the upper membrane of the noſe, occaſioned by acrid ſubſtances floating in the air, or by medicines called *ſternutatory*.

This irritation is performed either externally, by ſtrong ſmells, as marjoram, roſes, &c. or by duſt floating in the air, and taken in by inſpiration; or by ſharp pungent medicines, as creſſes and other ſternutatories, which vellicate the membrane of the noſe; or internally, by the acrimony of the lympha or mucus, which naturally moiſtens that membrane. The matters caſt forth in ſneezing come primarily from the noſe and throat; the pituitary membrane continually exuding a mucus thither; and, ſecondarily, from the breaſt, the trachea, and the bronchia of the lungs.

The practice of ſaluting the perſon who ſneezed exiſted in Africa, among nations unknown to the Greeks and Romans. The accounts we have of Monomotapa inform us *, that when the prince ſneezes, all his ſubjects in the capital are advertiſed of it, that they may offer up prayers for his ſafety. The author of the conqueſt of Peru aſſures us, that the cacique of Guachoia having ſneezed in preſence of the Spaniards, the Indians of his train fell proſtrate before him, ſtretched forth their hands, and diſplayed to him the accuſtomed marks of reſpect, while they invoked the ſun to enlighten him, to defend him, and to be his conſtant guard.

* *Strada, Prol. Acad.*

Every body knows that the Romans ſaluted each other on theſe occaſions: and Pliny relates†, that Tiberius exacted theſe ſigns of homage when drawn in his chariot. Superſtition, whoſe influence can debaſe every thing, had degraded this cuſtom for ſeveral ages, by attaching favourable or unfavourable omens to ſneezing according to the hour of the day or night, according to the ſigns of the zodiac, according as a work was more or leſs advanced, or according as one had ſneezed to the right or to the left ‡. If a man ſneezed at riſing from table or from his bed, it was neceſſary for him to ſit or lie down again. You are ſtruck with aſtoniſhment, ſaid Timotheus to the Athenians, who wiſhed to return into the harbour with their fleet §, becauſe he had ſneezed; you are ſtruck with aſtoniſhment, becauſe among 10,000 there is one man whoſe brain is moiſt.

† *Plin. Hiſt. Nat.* lib. ii. cap. 2.

‡ *Spond. Homeri Comment.*

§ *Frontin.* lib. i. cap. 11.

Polydore Virgil pretends, that in the time of Gregory the Great, there reigned in Italy an epidemic diſtemper, which carrried off by ſneezing all thoſe who were ſeized by it; and that this pontiff ordered prayers to be made againſt it, accompanied by certain ſigns of the croſs. But beſides that, there are very few caſes in which ſneezing can be conſidered as dangerous, and that it is frequently a favourable ſymptom ‖: it is evident, that we ought not to date from the ſixth century the origin of a cuſtom which loſes itſelf in the obſcurity of antiquity. Avicenna and Cardan ſay, it is a ſort of convulſion, which gives occaſion to dread an epilepſy, and that this diſeaſe is endeavoured to be warded off by prayers. Clement of Alexandria conſiders it as a mark of intemperance and effeminacy, which ought to be proſcribed. And he inveighs bitterly againſt thoſe

‖ *Hippocrat. Halleri Phyſ.*

Sneezing. who endeavour to procure ſneezing by external aid. Montaigne, on the contrary, explains this fact in a tone rather cynical. It is ſingular enough, that ſo many ridiculous, contradictory, and ſuperſtitious opinions, have not aboliſhed thoſe cuſtomary civilities which are ſtill preſerved equally among high and low; and which only the Anabaptiſts and Quakers have rejected, becauſe they have renounced ſalutations in every caſe.

Among the Greeks ſneezing was almoſt always a good omen. It excited marks of tenderneſs, of reſpect, and attachment. The genius of Socrates informed him by ſneezing, when it was neceſſary to perform any action*. The young Parthenis, hurried on by her paſſion, reſolved to write to Sarpedon an avowal of her love †; ſhe ſneezes in the moſt tender and impaſſioned part of her letter: This is ſufficient for her; this incident ſupplies the place of an anſwer, and perſuades her that Sarpedon is her lover. Penelope, haraſſed by the vexatious courtſhip of her ſuitors, begins to curſe them all, and to pour forth vows for the return of Ulyſſes ‡. Her ſon Telemachus interrupts her by a loud ſneeze. She inſtantly exults with joy, and regards this ſign as an aſſurance of the approaching return of her huſband. Xenophon was haranguing his troops; a ſoldier ſneezed in the moment when he was exhorting them to embrace a dangerous but neceſſary reſolution. The whole army, moved by this preſage, determine to purſue the project of their general; and Xenophon orders ſacrifices to Jupiter the preſerver §.

* *Plutarch de ſen. Socrat.*

† *Ariſtenaet.*

‡ *Homeri Odyſſ.* lib. xvii.

§ *Xenoph. Anab.*

This religious reverence for ſneezing, ſo ancient and ſo univerſal even in the times of Homer, always excited the curioſity of the Greek philoſophers and of the rabbins. Theſe laſt have ſpread a tradition, that, after the creation of the world, God made a general law to this purport, that every living man ſhould ſneeze but once in his life, and that at the ſame inſtant he ſhould render up his ſoul into the hand of his Creator ‖, without any preceding indiſpoſition. Jacob obtained an exemption from the common law, and the favour of being informed of his laſt hour: He ſneezed and did not die; and this ſign of death was changed into a ſign of life. Notice of this was ſent to all the princes of the earth; and they ordained, that in future ſneezing ſhould be accompanied with forms of bleſſing, and vows for the perſons who ſneezed.

‖ *Acad. des Inſcrip.* vol. iv.

Ariſtotle remounts likewiſe to the ſources of natural religion. He obſerves, that the brain is the origin of the nerves, of our ſentiments, our ſenſations, the ſeat of the ſoul, the image of the Divinity ¶; that upon all theſe accounts, the ſubſtance of the brain has ever been held in honour; that the firſt men ſwore by their head; that they durſt not touch nor eat the brains of any animal; that it was even a ſacred word which they dared not to pronounce. Filled with theſe ideas, it is not wonderful that they extended their reverence even to ſneezing. Such is the opinion of the moſt ancient and ſagacious philoſophers of Greece.

¶ *Ariſtot. in Prob.*

According to mythology, the firſt ſign of life Prometheus's artificial man gave was by ſternutation. This ſuppoſed creator is ſaid to have ſtolen a portion of the ſolar rays; and filling with them a phial, which he had made on purpoſe, ſealed it up hermetically. He inſtantly flies back to his favourite automaton, and opening the phial holds it cloſe to the ſtatue; the rays ſtill retaining all their activity, inſinuate themſelves through the pores, and ſet the factitious man a ſneezing. Prometheus, tranſported with the ſucceſs of his machine, offers up a fervent prayer, with wiſhes for the preſervation of ſo ſingular a being. His automaton obſerved him, remembering his ejaculations, was very careful, on the like occaſions, to offer theſe wiſhes in behalf of his deſcendants, who perpetuated it from father to ſon in all their colonies.

Sniggling ‖ Snoring.

SNIGGLING, a method of fiſhing for eels, chiefly uſed in the day-time, when they are found to hide themſelves near wears, mills, or flood gates. It is performed thus: Take a ſtrong line and hook, baited with a garden-worm, and obſerving the holes where the eels lie hid, thruſt your bait into them by the help of a ſtick; and if there be any, you ſhall be ſure to have a bite; and may, if your tackling hold, get the largeſt eels.

SNIPE, in ornithology. See SCOLOPAX and SHOOTING.

SNORING, in medicine, otherwiſe called *ſtertor*, is a ſound like that of the cerchnon, but greater and more manifeſt.

Many confound thoſe affections, and make them to differ only in place and magnitude, calling by the name of *ſtertor* that ſound or noiſe which is heard or ſuppoſed to be made in the paſſage between the palate and the noſtrils as in thoſe who ſleep; that boiling or bubbling noiſe, which in reſpiration proceeds from the larynx, or or head, or orifice of the aſpera arteria, they call *cerchon;* but if the ſound comes from the aſpera arteria itſelf, they will have it called *cerchnos*, that is, as ſome underſtand it, a rattling, or as others a ſtridulous or wheezing roughneſs of the aſpera arteria. In dying perſons this affection is called by the Greeks ῥεγχος, *rhenchos*, which is a ſnoring or rattling kind of noiſe, proceeding as it were from a conflict between the breath and the humours in the aſpera arteria.

This and ſuch like affections are owing to a weakneſs of nature, as when the lungs are full of pus or humours: to which purpoſe we read in the Prognoſtics of Hippocrates, "it is a bad ſign when there is no expectoration, and no diſcharge from the lungs, but a noiſe as from an ebullition is heard in the aſpera arteria from a plenitude of humour." Expectoration is ſuppreſſed either by the viſcidity of the humour, which requires to be diſcharged, and which adhering to the aſpera arteria, and being there agitated by the breath, excites that bubbling noiſe or ſtertor; or by an obſtruction of the bronchia; or, laſtly, by a compreſſion of the aſpera arteria and throat, whence the paſſage is ſtraitened, in which the humours being agitated, excite ſuch a kind of noiſe as before deſcribed. Hence Galen calls thoſe who are ſtrait-breaſted *ſtertorous*. That author aſſigns but two cauſes of this ſymptom, which are either the ſtraitneſs of the paſſage of reſpiration or redundance of humours, or both together; but it is neceſſary to add a third, to wit, the weakneſs of the faculty, which is the cauſe of the rhenchos in dying perſons, where nature is too weak to make diſcharges.

From what has been ſaid we conclude, that this ſymptom, or this ſort of fervour or ebullition in the throat, is not always mortal, but only when nature is oppreſſed with the redundance of humour, in ſuch a manner, that the lungs cannot diſcharge themſelves by ſpitting; or the paſſage appointed for the breath (being the aſpera arteria) is very much obſtructed, upon which account

Snow. account many dying perſons labour under a ſtertor with their mouths gaping.

SNOW, a well-known meteor, formed by the freezing of the vapours in the atmoſphere. It differs from hail and hoar-froſt, in being as it were cryſtallized, which they are not. This appears on examining a flake of ſnow by a magnifying glaſs; when the whole of it will appear to be compoſed of fine ſhining ſpicula diverging like rays from a centre. As the flakes fall down through the atmoſphere, they are continually joined by more of theſe radiated ſpicula, and thus increaſe in bulk like the drops of rain or hailſtones. Dr Grew, in a diſcourſe of the nature of ſnow, obſerves, that many parts thereof are of a regular figure, for the moſt part ſtars of ſix points, and are as perfect and tranſparent ice as any we ſee on a pond, &c. Upon each of theſe points are other collateral points, ſet at the ſame angles as the main points themſelves: among which there are divers other irregular, which are chiefly broken points, and fragments of the regular ones. Others alſo, by various winds, ſeem to have been thawed and frozen again into irregular cluſters; ſo that it ſeems as if the whole body of ſnow were an infinite maſs of icicles irregularly figured. That is, a cloud of vapours being gathered into drops, the ſaid drops forthwith deſcend; upon which deſcent, meeting with a freezing air as they paſs through a colder region, each drop is immediately frozen into an icicle, ſhooting itſelf forth into ſeveral points; but theſe ſtill continuing their deſcent, and meeting with ſome intermitting gales of warmer air, or in their continual waſtage to and fro touching upon each other, ſome of them are a little thawed, blunted, and again frozen into cluſters, or intangled ſo as to fall down in what we call *flakes*.

The lightneſs of ſnow, although it is firm ice, is owing to the exceſs of its ſurface, in compariſon to the matter contained under it; as gold itſelf may be extended in ſurface till it will ride upon the leaſt breath of air.

The whiteneſs of ſnow is owing to the ſmall particles into which it is divided; for ice, when pounded, will become equally white. An artificial ſnow has been made by the following experiment. A tall phial of aquafortis being placed by the fire till it is warm, and filings of pure ſilver, a few at a time, being put into it; after a briſk ebullition, the ſilver will diſſolve ſlowly. The phial being then placed in a cold window, as it cools the ſilver particles will ſhoot into cryſtals, ſeveral of which running together will form a flake of ſnow, which will deſcend to the bottom of the phial. While they are deſcending, they repreſent perfectly a ſhower of ſilver ſnow, and the flakes will lie upon one another at the bottom like real ſnow upon the ground.

According to Signior Beccaria, clouds of ſnow differ in nothing from clouds of rain, but in the circumſtance of cold that freezes them. Both the regular diffuſion of the ſnow, and the regularity of the ſtructure of its parts (particularly ſome figures of ſnow or hail which fall about Turin, and which he calls *roſette*), ſhow that clouds of ſnow are acted upon by ſome uniform cauſe like electricity; and he endeavours to ſhow how electricity is capable of forming theſe figures. He was confirmed in his conjectures by obſerving, that his apparatus for obſerving the electricity of the atmoſphere never failed to be electrified by ſnow as well as rain. Profeſſor Winthrop ſometimes found his apparatus electrified by ſnow when driven about by the wind, though it had not been affected by it when the ſnow itſelf was falling. A more intenſe electricity, according to Beccaria, unites the particles of hail more cloſely than the more moderate electricity does thoſe of ſnow, in the ſame manner as we ſee that the drops of rain which fall from thunder-clouds are larger than thoſe which fall from others, though the former deſcend through a leſs ſpace. Snow.

But we are not to conſider ſnow merely as a curious and beautiful phenomenon. The Great Diſpenſer of univerſal bounty has ſo ordered it, that it is eminently ſubſervient, as well as all the works of creation, to his benevolent deſigns. Were we to judge from appearances only, we might imagine, that ſo far from being uſeful to the earth, the cold humidity of ſnow would be detrimental to vegetation. But the experience of all ages aſſerts the contrary. Snow, particularly in thoſe northern regions where the ground is covered with it for ſeveral months, fructifies the earth, by guarding the corn or other vegetables from the intenſer cold of the air, and eſpecially from the cold piercing winds. It has been a vulgar opinion, very generally received, that ſnow fertilizes the lands on which it falls more than rain, in conſequence of the nitrous ſalts which it is ſuppoſed to acquire by freezing. But it appears from the experiments of Margraaf(A) in the year 1751, that the chemical difference between rain and ſnow-water is exceedingly ſmall; that the latter is ſomewhat leſs nitrous, and contains a ſomewhat leſs proportion of earth than the former; but neither of them contain either earth or any kind of ſalt in any quantity which can be ſenſibly efficacious in promoting vegetation. Allowing, therefore, that nitre is a fertilizer of lands, which many are upon good grounds diſpoſed utterly to deny, yet ſo very ſmall is the quantity of it contained in ſnow, that it cannot be ſuppoſed to promote the vegetation of plants upon which the ſnow has fallen. The peculiar agency of ſnow, as a fertilizer in preference to rain, may admit of a very rational explanation, without recurring to nitrous ſalts ſuppoſed to be contained in it. It may be rationally aſcribed to its furniſhing a covering to the roots of vegetables, by which they are guarded from the influence of the atmoſpherical cold, and the internal heat of the earth is prevented from eſcaping.

The internal parts of the earth, by ſome principle

(A) Margraaf collected of the pureſt ſnow he could find as much as when melted afforded 100 meaſures of water, each meaſure containing 36 ounces. By diſtilling this quantity he obtained 60 grains, not of *nitre*, but of *calcareous earth*, with ſome grains of the acid of ſea-ſalt, impregnated with a nitrous vapour. The ſame quantity of rain-water collected in the winter months with equal attention, when diſtilled yielded 100 grains of calcareous earth with ſome grains of the acid of nitre and ſea-ſalt. The chemical difference therefore between rain and ſnow is very ſmall.

Snow. which we do not underſtand, is heated uniformly to the 48th degree of Fahrenheit's thermometer. This degree of heat is greater than that in which the watery juices of vegetables freeze, and it is propagated from the inward parts of the earth to the ſurface, on which the vegetables grow. The atmoſphere being variably heated by the action of the ſun in different climates, and in the ſame climate at different ſeaſons, communicates to the ſurface of the earth and to ſome diſtance below it the degree of heat or cold which prevails in itſelf. Different vegetables are able to preſerve life under different degrees of cold, but all of them periſh when the cold which reaches their roots is extreme. Providence has therefore, in the coldeſt climates, provided a covering of ſnow for the roots of vegetables, by which they are protected from the influence of the atmoſpherical cold. The ſnow keeps in the internal heat of the earth, which ſurrounds the roots of vegetables, and defends them from the cold of the atmoſphere.

Snow or ice water is always deprived of its fixed air, which eſcapes during the proceſs of congelation. Accordingly, as ſome of the inhabitants of the Alps who uſe it for their conſtant drink have enormous wens upon their throats, it has been aſcribed to this circumſtance. If this were the cauſe of theſe wens, it would be eaſy to remove it by expoſing the ſnow-water to the air for ſome time. But ſeveral eminent phyſicians have rejected the notion that ſnow-water is the cauſe of theſe wens; for in Greenland, where ſnow-water is commonly uſed, the inhabitants are not affected with ſuch ſwellings: on the other hand, they are common in Sumatra where ſnow is never ſeen.

Snow, in ſea-affaire, is generally the largeſt of all two-maſted veſſels employed by Europeans, and the moſt convenient for navigation.

The ſails and rigging on the mainmaſt and foremaſt of a ſnow are exactly ſimilar to thoſe on the ſame maſts in a ſhip; only that there is a ſmall maſt behind the mainmaſt of the former, which carries a ſail nearly reſembling the mizen of a ſhip. The foot of this maſt is fixed on a block of wood on the quarter-deck abaft the mainmaſt; and the head of it is attached to the after-top of the maintop. The ſail which is called the *try-ſail* is extended from its maſt towards the ſtern of the veſſel.

When the ſloops of war are rigged as ſnows, they are furniſhed with a horſe, which anſwers the purpoſe of the tryſail-maſt, the fore-part of the ſail being attached by rings to the ſaid horſe, in different places of its height.

Snow-Grotto, an excavation made by the waters on the ſide of Mount Etna, by making their way under the layers of lava, and by carrying away the bed of pozzolana below them. It occurred to the proprietor, that this place was very ſuitable for a magazine of ſnow: for in Sicily, at Naples, and particularly at Malta, they are obliged for want of ice to make uſe of ſnow for cooling their wine, ſherbet, and other liquors, and for making ſweetmeats.

This grotto was hired or bought by the knights of Malta, who having neither ice nor ſnow on the burning rock which they inhabit, have hired ſeveral caverns on Etna, into which people whom they employ collect and preſerve quantities of ſnow to be ſent to Malta when needed. This grotto has therefore been repaired with-

in at the expence of that order; flights of ſteps are cut into it, as well as two openings from above, by which they throw in the ſnow, and through which the grotto is enlightened. Above the grotto they have alſo levelled a piece of ground of conſiderable extent: this they have incloſed with thick and lofty walls, ſo that when the winds, which at this elevation blow with great violence, carry the ſnow from the higher parts of the mountain, and depoſite it in this incloſure, it is retained and amaſſed by the walls. The people then remove it into the grotto through the two openings; and it is there laid up, and preſerved in ſuch a manner as to reſiſt the force of the ſummer heats; as the layers of lava with which the grotto is arched above prevent them from making any impreſſion. Snow, Snowdon-Hill.

When the ſeaſon for exporting the ſnow comes on, it is put into large bags, into which it is preſſed as cloſely as poſſible; it is then carried by men out of the grotto, and laid upon mules, which convey it to the ſhore, where ſmall veſſels are waiting to carry it away.

But before thoſe lumps of ſnow are put into bags, they are wrapped in freſh leaves; ſo that while they are conveyed from the grotto to the ſhore, the leaves may prevent the rays of the ſun from making any impreſſion upon them.

The Sicilians carry on a conſiderable trade in ſnow, which affords employment to ſome thouſands of mules, horſes, and men. They have magazines of it on the ſummits of their loftieſt mountains, from which they diſtribute it through all their cities, towns, and houſes; for every perſon in the iſland makes uſe of ſnow. They conſider the practice of cooling their liquors as abſolutely neceſſary for the preſervation of health; and in a climate the heat of which is conſtantly relaxing the fibres, cooling liquors, by communicating a proper tone to the fibres of the ſtomach, muſt greatly ſtrengthen them for the performance of their functions.

In this climate a ſcarcity of ſnow is no leſs dreaded than a ſcarcity of corn, wine, or oil. We are informed by a gentleman who was at Syracuſe in the year 1777, when there was a ſcarcity of ſnow, the people of the town learned that a ſmall veſſel loaded with that article was paſſing the coaſt: without a moment's deliberation they ran in a body to the ſhore and demanded her cargo; which when the crew refuſed to deliver up, the Syracuſans attacked and took, though with the loſs of ſeveral men.

Snow-Drop, in botany. See Chionanthus.

SNOWDON-hill, the name of a mountain in Caernarvonſhire in Wales, generally thought to be the higheſt in Britain; though ſome have been of opinion that its height is equalled, or even exceeded, by mountains in the Highlands of Scotland. The mountain is ſurrounded by many others, called in the Welſh language *Crib Coch*, *Crib y Diſtill*, *Lliweddy yr Arran*, &c.

According to Mr Pennant*, this mountainous tract yields ſcarcely any corn. Its produce is cattle and ſheep; which, during ſummer, keep very high in the mountains, followed by their owners with their families, who reſide during that ſeaſon in *havodtys*, or "ſummer dairy-houſes," as the farmers in the Swiſs Alps do in their *ſennes*. Theſe houſes conſiſt of a long low room, with a hole at one end to let out the ſmoke from the fire which is made beneath. Their furniture is very ſimple; ſtones are ſubſtituted for ſtools, and their beds are of hay, * Journey to Snowdon.

Snowdon-Hill.

hay, ranged along the ſides. They manufacture their own clothes, and dye them with the *lichen omphaloides* and *lichen parietinus*, moſſes collected from the rocks. During ſummer the men paſs their time in tending their herds or in making hay, &c. and the women in milking or in making butter and cheeſe. For their own uſe they milk both ewes and goats, and make cheeſe of the milk. Their diet conſiſts of milk, cheeſe, and butter: and their ordinary drink is whey; though they have, by way of reſerve, a few bottles of very ſtrong beer, which they uſe as a cordial when ſick. They are people of good underſtanding, wary, and circumſpect; tall, thin, and of ſtrong conſtitutions. In the winter-time they deſcend into the *hen-dref*, or "old dwelling," where they paſs their time in inactivity.

The view from the higheſt peak of Snowdon is very extenſive. From it Mr Pennant ſaw the county of Cheſter, the high hills of Yorkſhire, part of the north of England, Scotland, and Ireland; a plain view of the iſle of Man; and that of Angleſea appeared like a map extended under his feet, with every rivulet viſible. Our author took much pains to have this view to advantage; ſat up at a farm on the weſt till about 12, and walked up the whole way. The night was remarkably fine and ſtarry; towards morning the ſtars faded away, leaving an interval of darkneſs, which, however, was ſoon diſpelled by the dawn of day. The body of the ſun appeared moſt diſtinct, with the roundneſs of the moon, before it appeared too brilliant to be looked at. The ſea, which bounded the weſtern part of the proſpect, appeared gilt with the ſun-beams, firſt in ſlender ſtreaks, and at length glowed with redneſs. The proſpect was diſcloſed like the gradual drawing up of a curtain in a theatre; till at laſt the heat became ſufficiently ſtrong to raiſe miſts from the various lakes, which in a ſlight degree obſcured the proſpect. The ſhadow of the mountain extended many miles, and ſhowed its bicapitated form; the Wyddfa making one head, and Crib y Diſtill the other. At this time he counted between 20 and 30 lakes either in Caernarvon or in Merionethſhire. In making another viſit, the ſky was obſcured very ſoon after he got up. A vaſt miſt involved the whole circuit of the mountain, and the proſpect down was horrible. It gave an idea of numbers of abyſſes, concealed by a thick ſmoke furiouſly circulating around them. Very often a guſt of wind made an opening in the clouds, which gave a fine and diſtinct viſta of lake and valley. Sometimes they opened in one place, at others in many at once; exhibiting a moſt ſtrange and perplexing ſight of water, fields, rocks, and chaſms. They then cloſed again, and every thing was involved in darkneſs; in a few minutes they would ſeparate again, and repeat the above-mentioned ſcene with infinite variety. From this proſpect our traveller deſcended with great reluctance; but before he had reached the place where his horſes were left, he was overtaken by a thunder ſtorm. The rolling of the thunder-claps, being reiterated by the mountains, was inexpreſſibly awful; and after he had mounted, he was in great danger of being ſwept away by the torrents which poured down in conſequence of a very heavy rain.

It is very rare (Mr Pennant obſerves) that the traveller gets a proper day to aſcend this hill: it indeed often appears clear; but by the evident attraction of the clouds by this lofty mountain, it becomes ſuddenly and unexpectedly enveloped in miſt, when the clouds have juſt before appeared very high and very remote. At times he obſerved them lower to half their height; and notwithſtanding they have been diſperſed to the right and left, yet they have met from both ſides, and united to involve the ſummit in one great obſcurity.

The height of Snowdon was meaſured, in 1682, by Mr Caſwell, with inſtruments made by Flamſtead: according to his menſuration, the height is 3720 feet; but more modern computations make it only 3568, reckoning from the quay at Caernarvon to the higheſt peak. The ſtone that compoſes this mountain is exceſſively hard. Large coarſe cryſtals, and frequently cubic pyrites, are found in the fiſſures. An immenſe quantity of water ruſhes down the ſides of Snowdon and the neighbouring mountains, inſomuch that Mr Pennant ſuppoſes, if collected into one ſtream, they would exceed the waters of the Thames.

Snuff, Snyders.

SNUFF, a powder chiefly made of tobacco, the uſe of which is too well known to need any deſcription here.

Tobacco is uſually the baſis of ſnuff; other matters being only added to give it a more agreeable ſcent, &c. The kinds of ſnuff, and their ſeveral names, are infinite, and new ones are daily invented; ſo that it would be difficult, not to ſay impoſſible, to give a detail of them. We ſhall only ſay, that there are three principal ſorts: the firſt granulated; the ſecond an impalpable powder; and the third the bran, or coarſe part remaining after ſifting the ſecond ſort.

"Every profeſſed, inveterate, and incurable ſnuff-taker (ſays Lord Stanhope), at a moderate computation, takes one pinch in ten minutes. Every pinch, with the agreeable ceremony of blowing and wiping the noſe and other incidental circumſtances, conſumes a minute and a half. One minute and a half out of every ten, allowing 16 hours to a ſnuff-taking day, amounts to two hours and 24 minutes out of every natural day, or one day out of every ten. One day out of every 10 amounts to 36 days and a half in a year. Hence if we ſuppoſe the practice to be perſiſted in 40 years, two entire years of the ſnuff-taker's life will be dedicated to tickling his noſe, and two more to blowing it. The expence of ſnuff, ſnuff-boxes, and handkerchiefs, will be the ſubject of a ſecond eſſay; in which it will appear, that this luxury encroaches as much on the income of the ſnuff-taker as it does on his time; and that by a proper application of the time and money thus loſt to the public, a fund might be conſtituted for the diſcharge of the national debt." See NICOTIANA.

SNYDERS (Francis), a Flemiſh painter, born at Antwerp in 1579, and bred under his countryman Henry Van Balen. His genius firſt diſplayed itſelf in painting fruit: he afterwards attempted animals, huntings, &c. in which he exceeded all his predeceſſors. He alſo painted kitchens, &c. and gave dignity to ſubjects that ſeemed incapable of it. He was made painter to Ferdinand and Iſabella, archduke and ducheſs, and became attached to the houſe of the cardinal infant of Spain. The king of Spain and the elector Palatine adorned their palaces with huntings by this artiſt. Rubens, Jordaens, and Snyders, uſed to co-operate in the enriching of each other's pictures according to their

Soal-fish, Soap.

several talents; and thus they became more valuable than if finiſhed by either of them ſingly. Snyders died in 1657.

SOAL-FISH, in ichthyology. See PLEURONECTES.

SOAP, a compoſition of cauſtic, fixed alkaline ſalt, and oil, ſometimes hard and dry, ſometimes ſoft and liquid; much uſed in waſhing, whitening linens, and by dyers and fullers.—Soap may be made by ſeveral methods, which, however, all depend upon the ſame principle. The ſoap which is uſed in medicine is made without heat. See CHEMISTRY, n° 1026.

In manufactures where large quantities of it are prepared, ſoap is made with heat. A lixivium of quicklime and ſoda is made, but is leſs concentrated than that above referred to, and only ſo much that it can ſuſtain a freſh egg. A part of this lixivium is to be even diluted and mixed with an equal weight of oil of olives. The mixture is to be put on a gentle fire, and agitated, that the union may be accelerated. When the mixture begins to unite well, the reſt of the lixivium is to be added to it; and the whole is to be digeſted with a very gentle heat, till the ſoap be completely made. A trial is to be made of it, to examine whether the juſt proportion of oil and alkali has been obſerved. Good ſoap of this kind ought to be firm, and very white when cold; not ſubject to become moiſt by expoſure to air, and entirely miſcible with pure water, to which it communicates a milky appearance, but without any drops of oil floating on the ſurface. When the ſoap has not theſe qualities, the combination has not been well made, or the quantity of ſalt or of oil is too great, which faults muſt be corrected

In ſoft or liquid ſoaps, green or black ſoaps, cheaper oils are employed, as oil of nuts, of hemp, of fiſh, &c. Theſe ſoaps, excepting in conſiſtence, are not eſſentially different from white ſoap.

Fixed alkalis are much diſpoſed to unite with oils that are not volatile, both vegetable and animal, ſince this union can be made even without heat. The compound reſulting from this union partakes at the ſame time of the properties of oil and of alkali; but theſe properties are modified and tempered by each other, according to the general rule of combinations. Alkali formed into ſoap has not nearly the ſame acrimony as when it is pure; it is even deprived of almoſt all its cauſticity, and its other ſaline alkaline properties are almoſt entirely aboliſhed. The ſame oil contained in ſoap is leſs combuſtible than when pure, from its union with the alkali, which is an uninflammable body. It is miſcible, or even ſoluble, in water, to a certain degree, by means of the alkali. Soap is entirely ſoluble in ſpirit of wine; and ſtill better in aquavitæ ſharpened by a little alkaline ſalt, according to an obſervation of Mr Geoffroy.

The manufacture of ſoap in London firſt began in the year 1524; before which time this city was ſerved with white ſoap from foreign countries, and with grey ſoap ſpeckled with white from Briſtol, which was ſold for a penny a pound; and alſo with black ſoap, which ſold for a halfpenny the pound.

The principal ſoaps of our own manufacture are the ſoft, the hard, and the ball ſoap. The ſoft ſoap is either white or green. The proceſs of making each of theſe ſhall now be deſcribed.

Soap.

Green ſoft ſoap. The chief ingredients uſed in making this are lees drawn from pot-aſh and lime, boiled up with tallow and oil. Firſt, the ley of a proper degree of ſtrength (which muſt be eſtimated by the weight of the liquor), and tallow, are put into the copper together, and as ſoon as they boil up the oil is added; the fire is then damped or ſtopped up, while the ingredients remain in the copper to unite; when they are united, the copper is again made to boil, being fed or filled with lees as it boils, till there be a ſufficient quantity put into it; then it is boiled off and put into caſks. When this ſoap is firſt made it appears uniform; but in about a week's time the tallow ſeparates from the oil into thoſe white grains which we ſee in common ſoap. Soap thus made would appear yellow, but by a mixture of indigo added at the end of the boiling, it is rendered green, that being the colour which reſults from the mixture of yellow and blue.

White ſoap. Of this one ſort is made after the ſame manner as green ſoft ſoap, oil alone excepted, which is not uſed in white. The other ſort of white ſoft ſoap is made from the lees of aſhes of lime boiled up two different times with tallow. Firſt, a quantity of lees and tallow are put into the copper together, and kept boiling, being fed with lees as they boil, until the whole is boiled ſufficiently; then the lees are ſeparated or diſcharged from the tallowiſh part, which part is removed into a tub, and the lees are thrown away; this is called the *firſt half-boil*: then the copper is filled again with freſh tallow and lees, and the firſt half-boil is put out of the tub into the copper a ſecond time, where it is kept boiling with freſh lees and tallow till the ſoap is produced. It is then put out of the copper into the ſame ſort of caſks as are uſed for green ſoft ſoap. The common ſoft ſoap uſed about London, generally of a greeniſh hue, with ſome white lumps, is prepared chiefly with tallow: a blackiſh ſort, more common in ſome other places, is ſaid to be made with whale oil.

Hard ſoap is made with lees from aſhes and tallow, and is moſt commonly boiled twice: the firſt, called the *half-boil*, hath the ſame operation as the firſt half-boil of ſoft white ſoap. Then the copper is charged with freſh lees again, and the firſt half boil put into it, where it is kept boiling, and fed with lees as it boils, till it grains or is boiled enough; then the ley is diſcharged from it, and the ſoap put into a frame to cool and harden. Common ſalt is made uſe of for the purpoſe of graining the ſoap; for when the oil or tallow has been united with the ley, after a little boiling, a quantity of ſalt is thrown into the maſs, which diſſolving readily in water, but not in the oil or tallow, draws out the water in a conſiderable degree, ſo that the oil or tallow united with the ſalt of the ley ſwims on the top. When the ley is of a proper ſtrength, leſs ſalt is neceſſary to raiſe the curd than when it is too weak. It muſt be obſerved, that there is no certain time for bringing off a boiling of any of theſe ſorts of ſoap: it frequently takes up part of two days.

Ball ſoap, commonly uſed in the north, is made with lees from aſhes and tallow. The lees are put into the copper, and boiled till the watery part is quite gone, and there remains nothing in the copper but a ſort of ſaline matter (the very ſtrength or eſſence of the ley); to this the tallow is put, and the copper is kept boiling and ſtirring for above half an hour, in which time the

Soap. the ſoap is made; and then it is put out of the copper into tubs or baſkets with ſheets in them, and immediately (whilſt ſoft) made into balls. It requires near 24 hours in this proceſs to boil away the watery part of the ley.

When oil unites with alkali in the formation of ſoap, it is little altered in the connection of its principles; for it may be ſeparated from the alkali by decompoſing ſoap with any acid, and may be obtained nearly in its original ſtate.

Concerning the decompoſition of ſoap by means of acids, we muſt obſerve, firſt, that all acids, even the weakeſt vegetable acids, may occaſion this decompoſition, becauſe every one of them has a greater affinity than oil with fixed alkali. Secondly, theſe acids, even when united with any baſis, excepting fixed alkali, are capable of occaſioning the ſame decompoſition; whence all ammoniacal ſalts, all ſalts with baſis of earth, and all thoſe with metallic baſes, are capable of decompoſing ſoap, in the ſame manner as diſengaged acids are; with this difference, that the oil ſeparated from the fixed alkali, by the acid of theſe ſalts, may unite more or leſs intimately with the ſubſtance which was the baſis of the neutral ſalt employed for the decompoſition.

Soap may alſo be decompoſed by diſtillation, as Lemery has done. When firſt expoſed to fire, it yields a phlegm called by him a *ſpirit*; which nevertheleſs is neither acid nor alkaline, but ſome water which enters into the compoſition of ſoap. It becomes more and more coloured and empyreumatic as the fire is increaſed, which ſhows that it contains the moſt ſubtle part of the oil. It ſeems even to raiſe along with it, by help of the oil and action of the fire, a ſmall part of the alkali of the ſoap: for, as the ſame chemiſt obſerves, it occaſions a precipitate in a ſolution of corroſive ſublimate. After this phlegm the oil riſes altered, preciſely as if it had been diſtilled from quicklime, that is, empyreumatic, ſoluble in ſpirit of wine, at firſt ſufficiently ſubtle and afterwards thicker. An alkaline reſiduous coal remains in the retort, conſiſting chiefly of the mineral alkali contained in the ſoap, and which may be diſengaged from the coal by calcination in an open fire, and obtained in its pure ſtate.

Alkaline ſoaps are very uſeful in many arts and trades, and alſo in chemiſtry and medicine. Their principal utility conſiſts in a deterſive quality that they receive from their alkali, which, although it is in ſome meaſure ſaturated with oil, is yet capable of acting upon oily matters, and of rendering them ſaponaceous and miſcible with water. Hence ſoap is very uſeful to cleanſe any ſubſtances from all fat matters with which they happen to be ſoiled. Soap is therefore daily uſed for the waſhing and whitening of linen, for the cleanſing of woollen-cloths from oil, and for whitening ſilk and freeing it from the reſinous varniſh with which it is naturally covered. Pure alkaline lixiviums being capable of diſſolving oils more effectually than ſoap, might be employed for the ſame purpoſes; but when this activity is not mitigated by oil, as it is in ſoap, they are capable of altering, and even of deſtroying entirely by their cauſticity, moſt ſubſtances, eſpecially animal matters, as ſilk, wool, and others: whereas ſoap cleanſes from oil almoſt as effectually as pure alkali, without danger of altering or deſtroying; which renders it very uſeful.

Soap was imperfectly known to the ancients. It is mentioned by Pliny as made of fat and aſhes, and as an invention of the Gauls. Aretæus and others inform us, that the Greeks obtained their knowledge of its medical uſe from the Romans. Its virtues, according to Bergius, are detergent, reſolvent, and aperient, and its uſe recommended in jaundice, gout, calculous complaints, and in obſtructions of the viſcera. The efficacy of ſoap in the firſt of theſe diſeaſes was experienced by Sylvius, and ſince recommended very generally by various authors who have written on this complaint; and it has alſo been thought of uſe in ſupplying the place of bile in the primæ viæ. The utility of this medicine in icterical caſes was inferred chiefly from its ſuppoſed power of diſſolving biliary concretions; but this medicine has loſt much of its reputation in jaundice, ſince it is now known that gall-ſtones have been found in many after death who had been daily taking ſoap for ſeveral months and even years. Of its good effects in urinary calculous affections, we have the teſtimony of ſeveral, eſpecially when diſſolved in lime-water, by which its efficacy is conſiderably increaſed; for it thus becomes a powerful ſolvent of mucus, which an ingenious modern author ſuppoſes to be the chief agent in the formation of calculi: it is, however, only in the incipient ſtate of the diſeaſe that theſe remedies promiſe effectual benefit; though they generally abate the more violent ſymptoms where they cannot remove the cauſe. With Boerhaave ſoap was a general medicine: for as he attributed moſt complaints to viſcidity of the fluids, he, and moſt of the Boerhaavian ſchool, preſcribed it in conjunction with different reſinous and other ſubſtances, in gout, rheumatiſm, and various viſceral complaints. Soap is alſo externally employed as a reſolvent, and gives name to ſeveral officinal preparations. Soap. *Woodville's Medical Botany*, p. 390.

From the properties of ſoap we may know that it muſt be a very effectual and convenient anti-acid. It abſorbs acids as powerfully as pure alkalis and abſorbent earths, without having the cauſticity of the former, and without oppreſſing the ſtomach by its weight like the latter.

Laſtly, we may perceive that ſoap muſt be one of the beſt of all antidotes to ſtop quickly, and with the leaſt inconvenience, the bad effects of acid corroſive poiſons, as aquafortis, corroſive ſublimate, &c.

Soap imported is ſubject by 10 Ann. cap. 19. to a duty of 2d. a pound (over and above former duties); and by 12 Ann. ſtat. 2. cap. 9. to the farther ſum of 1d. a pound. And by the ſame acts, the duty on ſoap made in the kingdom is 1½d. a pound. By 17 G. III. cap. 52. no perſon within the limits of the head office of exciſe in London ſhall be permitted to make any ſoap unleſs he occupy a tenement of 10l. a year, be aſſeſſed, and pay the pariſh rates; or elſewhere, unleſs he be aſſeſſed, and pay to church and poor. Places of making are to be entered on pain of 50l. and covers and locks to be provided under a forfeiture of 100l.; the furnace-door of every utenſil uſed in the manufacture of ſoap ſhall be locked by the exciſe officer, as ſoon as the fire is damped or drawn out, and faſtenings provided, under the penalty of 50l.; and opening or damaging ſuch faſtening incurs a penalty of 100l. Officers are required to enter and ſurvey at all times, by day or night, and the penalty of obſtructing is 20l. and they may unlock and examine every copper, &c. between the hours of five in the morning and ele-

Soap || Socage.

ven in the evening, and the penalty of obſtructing is 100 l. Every maker of ſoap before he begins any making, if within the bills of mortality, ſhall give 12 hours, if elſewhere 24 hours, notice in writing to the officer, of the time when he intends to begin, on pain of 50 l. No maker ſhall remove any ſoap unſurveyed on pain of 20 l. without giving proper notice of his intention. And if any maker ſhall conceal any ſoap or materials, he ſhall forfeit the ſame, and alſo 500 l. Every barrel of ſoap ſhall contain 256 lb. avoirdupois, half barrel 128 lb. firkin 64 lb. half-firkin 32 lb. beſides the weight or tare of each caſk: and all ſoap, excepting hard cake ſoap and ball ſoap, ſhall be put into ſuch caſks and no other, on pain of forfeiture, and 5 l. The maker ſhall weekly enter in writing at the next office the ſoap made by him in each week, with the weight and quantity at each boiling, on pain of 50 l.; and within one week after entry clear off the duties, on pain of double duty. See, beſides the ſtatutes above cited, 5 Geo. III. cap. 43. 12 Geo. III. cap. 46. 11 Geo. cap. 30. 1 Geo. ſtat. 2. cap. 36.

Starkey's Soap. See CHEMISTRY, n° 1027.

Acid Soap. This is formed by the addition of concentrated acids to the expreſſed oils. Thus the oil is rendered partially ſoluble in water; but the union is not ſufficiently complete to anſwer any valuable purpoſe.

Soap-Berry Tree. See SAPINDUS.

Soap-Earth. See STEATITES.

SOAPWORT. See SAPONARIA.

SOC (Sax.), ſignifies power or liberty to miniſter juſtice or execute laws: alſo the circuit or territory wherein ſuch power is exerciſed. Whence our law-Latin word *ſocca* is uſed for a ſeigniory or lordſhip enfranchiſed by the king, with the liberty of holding or keeping a court of his *ſockmen*: And this kind of liberty continues in divers parts of England to this day, and is known by the names of *ſoke* and *ſoken*.

SOCAGE, in its moſt general and extenſive ſignification, ſeems to denote a tenure by any certain and determinate ſervice. And in this ſenſe it is by our ancient writers conſtantly put in oppoſition to chivalry or knight-ſervice, where the render was precarious and uncertain. The ſervice muſt therefore be certain, in order to denominate it ſocage; as to hold by fealty and 20 s. rent; or, by homage, fealty, and 20 s. rent; or, by homage and fealty without rent; or, by fealty and certain corporal ſervice, as ploughing the lord's land for three days; or, by fealty only without any other ſervice: for all theſe are tenures in ſocage.

Blackſt. Comment. vol. ii.

Socage is of two ſorts: *free*-ſocage, where the ſervices are not only certain but honourable; and *villein*-ſocage, where the ſervices, though certain, are of a baſer nature (ſee VILLENAGE). Such as hold by the former tenure are called, in Glanvil and other ſubſequent authors, by the name of *liberi ſokemanni*, or tenants in free-ſocage. The word is derived from the Saxon appellation *ſoc*, which ſignifies liberty or privilege; and, being joined to an uſual termination, is called *ſocage*, in Latin *ſocagium*; ſignifying thereby a free or privileged tenure.

It ſeems probable that the ſocage-tenures were the relics of Saxon liberty; retained by ſuch perſons as had neither forfeited them to the king, nor been obliged to exchange their tenure for the more honourable, as it was called, but at the ſame time more burthenſome, tenure of knight-ſervice. This is peculiarly remarkable in the tenure which prevails in Kent, called *gavelkind*, which is generally acknowledged to be a ſpecies of ſocage-tenure; the preſervation whereof inviolate from the innovations of the Norman conqueror is a fact univerſally known. And thoſe who thus preſerved their liberties were ſaid to hold in free and common ſocage.

Society.

As therefore the grand criterion and diſtinguiſhing mark of this ſpecies of tenure are the having its renders or ſervices aſcertained, it will include under it all other methods of holding free lands by certain and invariable rents and duties; and in particular, *Petit SERJEANTY*, *Tenure in BURGAGE*, and GAVELKIND. See theſe articles.

SOCIETY, a number of rational and moral beings, united for their common preſervation and happineſs.

1 Definition.

There are ſhoals of fiſhes, herds of quadrupeds, and flocks of birds. But till obſervation enable us to determine with greater certainty, how far the inferior animals are able to look through a ſeries of means to the end which theſe are calculated to produce, how far their conduct may be influenced by the hope of reward and the fear of puniſhment, and whether they are at all capable of moral diſtinctions—we cannot with propriety apply to them the term *Society*. We call crows, and beavers, and ſeveral other ſpecies of animals, *gregarious*; but it is hardly good Engliſh to ſay that they are *ſocial*.

2 How far brutes are capable of a ſocial ſtate.

It is only human ſociety, then, that can become the ſubject of our preſent inveſtigation. The phenomena which it preſents are highly worthy of our notice.

3 Mankind the only ſocial beings ſubject to our obſervation

Such are the advantages which each individual evidently derives from living in a ſocial ſtate; and ſo helpleſs does any human being appear in a ſolitary ſtate, that we are naturally led to conclude, that if there ever was a period at which mankind were ſolitary beings, that period could not be of long duration; for their averſion to ſolitude and love of ſociety would ſoon induce them to enter into ſocial union. Such is the opinion which we are led to conceive, when we compare our own condition as members of civilized and enlightened ſociety with that of the brutes around us, or with that of ſavages in the earlier and ruder periods of ſocial life. When we hear of Indians wandering naked through the woods, deſtitute of arts, unſkilled in agriculture, ſcarce capable of moral diſtinctions, void of all religious ſentiments, or poſſeſſed with the moſt abſurd notions concerning ſuperior powers, and procuring means of ſubſiſtence in a manner equally precarious with that of the beaſts of prey—we look down with pity on their condition, or turn from it with horror. When we view the order of cultivated ſociety, and conſider our inſtitutions, arts, and manners—we rejoice over our ſuperior wiſdom and happineſs.

4 A ſocial and a ſavage ſtate.

Man in a civilized ſtate appears a being of a ſuperior order to man in a ſavage ſtate; yet ſome philoſophers tell us, that it is only he who, having been educated in ſociety, has been taught to depend upon others, that can be helpleſs or miſerable when placed in a ſolitary ſtate. They view the ſavage who exerts himſelf with intrepidity to ſupply his wants, or bears them with fortitude, as the greateſt hero, and poſſeſſing the greateſt happineſs. And therefore if we agree with them, that the propenſities of nature may have prompted men to

7 enter

Society. enter into ſocial union, though they may have hoped to enjoy ſuperior ſecurity and happineſs by engaging to protect and ſupport each other, we muſt conclude that the Author of the univerſe has deſtined man to attain greater dignity and happineſs in a ſavage and ſolitary than in a ſocial ſtate; and therefore that thoſe diſpoſitions and views which lead us to ſociety are fallacious and inimical to our real intereſt.

Whatever be the ſuppoſed advantages of a ſolitary ſtate, certain it is that mankind, at the earlieſt periods, were united in ſociety. Various theories have been formed concerning the circumſtances and principles which gave riſe to this union: but we have elſewhere ſhown, that the greater part of them are founded in error; that they ſuppoſe the original ſtate of man to have been that of ſavages; and that ſuch a ſuppoſition is contradicted by the moſt authentic records of antiquity. For though the records of the earlier ages are generally obſcure, fabulous, and imperfect; yet happily there is *one* free from the imperfections of the reſt, and of undoubted authenticity, to which we may ſafely have recourſe†. This record is the Pentateuch of Moſes, which preſents us with a genuine account of the origin of man and of ſociety, perfectly conſonant to what we have laid down in the article referred to (ſee SAVAGE).

† See *Scripture*, n° 7—25.

5 First ſtate of ſociety according to authentic hiſtory.

According to Moſes, the firſt ſociety was that of a huſband and wife united in the bonds of marriage: the firſt government that of a father and huſband, the maſter of his family. Men lived together under the patriarchal form of government while they employed themſelves chiefly in tending flocks and herds. Children in ſuch circumſtances cannot ſoon riſe to an equality with their parents, where a man's importance depends on his property, not on his abilities. When flocks and herds are the chief articles of property, the ſon can only obtain theſe from his father; in general therefore the ſon muſt be entirely dependent on the father for the means of ſubſiſtence. If the parent during his life beſtow on his children any part of his property, he may do it on ſuch conditions as ſhall make their dependence upon him continue till the period of his death. When the community are by this event deprived of their head, inſtead of continuing in a ſtate of union, and ſelecting ſome one from among themſelves whom they may inveſt with the authority of a parent, they ſeparate into ſo many diſtinct tribes, each ſubjected to the authority of a different lord, the maſter of the family, and the proprietor of all the flocks and herds belonging to it. Such was the ſtate of the firſt ſocieties which the narrative of Moſes exhibits to our attention.

6 Theories of philoſophers concerning the origin of ſociety

Thoſe philoſophers who have made ſociety, in its various ſtages between rudeneſs and refinement, the ſubject of their ſpeculations, have generally conſidered mankind, in whatever region of the globe, and under whatever climate, as proceeding uniformly through certain regular gradations from one extreme to the other. They regard them, firſt, as gaining a precarious ſubſiſtence by gathering the ſpontaneous fruits of the earth, preying on the inhabitants of the waters, if placed on the ſea-ſhore, or along the banks of large rivers; or hunting wild beaſts, if in a ſituation where theſe are to be found in abundance, without foreſight or induſtry to provide for future wants when the preſent call of appetite is gratified. Next, they ſay, man riſes to the ſhepherd ſtate, and next to that of huſbandmen, when they turn their attention from the management of flocks to the cultivation of the ground. Next, theſe huſbandmen improve their powers, and better their condition, by becoming artizans and merchants; and the beginning of this period is the boundary between barbarity and civilization. Society.

Theſe are the ſtages through which they who have employed themſelves on the natural hiſtory of ſociety have generally conducted mankind in their progreſs from rudeneſs to refinement: but they ſeem to have overlooked the manner in which mankind were at firſt eſtabliſhed on this earth; for the circumſtances in which the parents of the human race were originally placed; for the degree of knowledge communicated to them; and for the inſtruction which they muſt have been capable of communicating to their poſterity. They rather appear to conſider the inhabitants of every different region of the globe as aborigines, ſpringing at firſt from the ground, or dropped on the ſpot which they inhabit; no leſs ignorant than infants of the nature and relations of the objects around them, and of the purpoſes which they may accompliſh by the exerciſe of their organs and faculties.

7 Are fanciful.

The abſurdity of this theory has been fully demonſtrated in another place: and if we agree to receive the Moſaic account of the original eſtabliſhment of mankind, we ſhall be led to view the phenomena of ſocial life in a light very different. We muſt firſt allow, that though many of the rudeſt tribes are found in the ſtate of *hunters* or *fiſhers*; yet the hunting or fiſhing ſtate cannot have been invariably the primary form of ſociety. Notwithſtanding the powers with which we are endowed, we are in a great meaſure the creatures of circumſtances. Phyſical cauſes exert, though indirectly, a mighty influence in forming the character and directing the exertions of the human race. From the information of Moſes we gather, that the firſt ſocieties of men lived under the patriarchal form of government, and employed themſelves in the cultivation of the ground and the management of flocks. And as we know that mankind, being ſubjected to the influence both of phyſical and moral cauſes, are no leſs liable to degeneracy than capable of improvement; we may eaſily conceive, that though deſcending all from the ſame original pair, and though enlightened with much traditionary knowledge relative to the arts of life, the order of ſociety, moral diſtinctions, and religious obligations; yet as they were gradually, and by various accidents, diſperſed over the earth, being removed to ſituations in which the arts with which they were acquainted could but little avail them, where induſtry was overpowered, or indolence encouraged by the ſeverity or the profuſion of nature, they might degenerate and fall into a condition almoſt as humble and precarious as that of the brutal tribes. Other moral cauſes might alſo concur to debaſe or elevate the human character in that early period. The particular character of the original ſettlers in any region, the manner in which they were connected with one another, and the arts which they were beſt qualified to exerciſe, with various other cauſes of a ſimilar nature, would have conſiderable influence in determining the character of the ſociety.

When laying aſide the ſpirit of theory and ſyſtem, we ſet ourſelves, with due humility, to trace facts, and to liſten to evidence, though our diſcoveries may be

Society. fewer than we ſhould otherwiſe fancy them; yet the knowledge which we thus acquire will be more uſeful and ſolid, and our ſpeculations more conſiſtent with the ſpirit of true philoſophy. Here, though we learn from the information of the ſacred writings, that the firſt family of mankind was not cruelly expoſed in this world, as children whom the inhumanity of their parents induces them to deſert; yet we are not, in conſequence of admitting this fact, laid under any neceſſity of denying or explaining away any of the other phenomena which occur to our obſervation when tracing the natural hiſtory of ſociety. Tradition may be corrupted; arts and ſciences may be loſt; the ſublimeſt religious doctrines may be debaſed into abſurdity.

If then we are deſirous of ſurveying ſociety in its rudeſt form, we muſt look, not to the earlieſt period of its exiſtence, but to thoſe diſtricts of the globe where external circumſtances concur to drive them into a ſtate of ſtupidity and wretchedneſs. Thus in many places of the happy clime of Aſia, which a variety of ancient records concur with the ſacred writings in repreſenting as the firſt peopled quarter of the globe, we cannot trace the form of ſociety backwards beyond the ſhepherd ſtate. In that ſtate indeed the bonds which connect ſociety extend not to a wide range of individuals, and men remain for a long period in diſtinct families; but

8 Yet in ſome particular inſtances realized.

yet that ſtate is highly favourable to knowledge, to happineſs, and to virtue. Again, the torrid and the frozen regions of the earth, though probably peopled at a later period, and by tribes ſprung from the ſame ſtock with the ſhepherds of Aſia, have yet exhibited mankind in a much lower ſtate. It is in the parched deſerts of Africa and the wilds of America that human beings have been found in a condition approaching the neareſt to that of the brutes.

We may therefore with ſome propriety deſert the order of time, and take a view of the different ſtages through which philoſophers have conſidered mankind as advancing, beginning with that of rudeneſs, though we have ſhown that it cannot have been the firſt in the progreſs.

9 Rudeſt ſtate or firſt ſtage of ſociety.

Where the human ſpecies are found in the loweſt and rudeſt ſtate, their rational and moral powers are very faintly diſplayed; but their external ſenſes are acute, and their bodily organs active and vigorous. Hunting and fiſhing are then their chief employments on which they depend for ſupport. During that portion of their time which is not ſpent in theſe purſuits, they are ſunk in liſtleſs indolence. Deſtitute of foreſight, they are rouſed to active exertion only by the preſſure of immediate neceſſity or the urgent calls of appetite. Accuſtomed to endure the ſeverity of the elements, and but ſcantily provided with the means of ſubſiſtence, they acquire habits of reſignation and fortitude, which are beheld with aſtoniſhment by thoſe who enjoy the plenty and indulgence of cultivated life. But in this ſtate of want and depreſſion, when the powers and poſſeſſions of every individual are ſcarce ſufficient for his own ſupport, when even the calls of appetite are repreſſed becauſe they cannot always be gratified, and the more refined paſſions, which either originate from ſuch as are merely animal, or are intimately connected with them, have not yet been felt—in this ſtate all the milder affections are unknown; or if the breaſt is at all ſenſible to their impulſe, it is extremely feeble. Huſband and wife, parent and child, brother and brother, are united by the weakeſt ties. Want and misfortune are not pitied. Why indeed ſhould they, where they cannot be relieved? It is impoſſible to determine how far beings in this condition can be capable of moral diſtinctions. One thing certain is, that in no ſtate are the human race entirely incapable of theſe. If we liſten, however, to the relations of reſpectable travellers, we muſt admit that human beings have ſometimes been found in that abject ſtate where no proper ideas of ſubordination, government, or diſtinction of ranks, could be formed. No diſtinct notions of Deity can be here entertained. Beings in ſo humble a condition cannot look through the order of the univerſe and the harmony of nature to that Eternal Wiſdom and Goodneſs which contrived, and that Almighty Power which brought into exiſtence, the ſyſtem of things. Of arts they muſt be almoſt totally deſtitute. They may uſe ſome inſtruments for fiſhing or the chace; but theſe muſt be extremely rude and ſimple. If they be acquainted with any means to ſhelter them from the inclemency of the elements, both their houſes and clothing will be aukward and inconvenient. Society.

10 Second ſtage in the progreſs of ſociety.

But human beings have not been often found in ſo rude a ſtate as this. Even thoſe tribes which we denominate ſavage, are for the moſt part farther removed from mere animal life. They generally appear united under ſome ſpecies of government, exerciſing the powers of reaſon, capable of morality, though that morality be not always very refined; diſplaying ſome degree of ſocial virtues, and acting under the influence of religious ſentiments. Thoſe who may be conſidered as but one degree higher in the ſcale than the ſtupid and wretched beings whoſe condition we have ſurveyed, are to be found ſtill in the hunting and fiſhing ſtate; but they are farther advanced towards ſocial life, and are become more ſenſible to the impulſe of ſocial affection. By unavoidable intercourſe in their employments, a few individual hunters or fiſhers contract a certain degree of fondneſs for each other's company, and are led to take ſome part in each other's joys and ſorrows; and when the ſocial affections thus generated (ſee PASSION) begin to exert themſelves, all the other powers of the mind are at the ſame time called forth, and the circumſtances of the little ſociety are immediately improved. We behold its members in a more comfortable condition, and find reaſon to view the human character with more complacency and reſpect. Huts are now built, more commodious clothes are faſhioned, inſtruments for the annoyance of wild beaſts and even of enemies are contrived; in ſhort, arts, and ſcience, and ſocial order, and religious ſentiments, and ceremonies, now make their appearance in the riſing ſociety, and ſerve to characterize it by the particular form which diſtinguiſhes each of them. But though ſocial order is no longer unknown nor unobſerved, yet the form of government is ſtill extremely ſimple, and its ties are but looſe and feeble. It will perhaps bear ſome reſemblance to the patriarchal; only all its members are on a more equal footing, and at the ſame time leſs cloſely connected than in the ſhepherd ſtate, to which that form of government ſeems almoſt peculiar. The old men are treated with veneration; but the young are not entirely ſubject to them. They may liſten reſpectfully to their advice; but they do not ſubmit to their arbitrary commands.

Society. commands. Where mankind are in the ſtate of hunters and fiſhers, where the means of ſubſiſtence are precarioufly acquired, and prudent foreſight does not prompt to accumulate much proviſion for the future, no individual can acquire comparative wealth. As ſoon as the ſon is grown up, he ceaſes to be dependent on his father, as well as on the ſociety in general. Difference of experience therefore conſtitutes the only diſtinction between the young and the old; and if the old have experience, the young have ſtrength and activity. Here, then, neither age nor property can give riſe to any ſtriking diſtinction of ranks. All who have attained to manhood, and are not diſabled by unuſual deficiency of ſtrength or agility, or by the infirmities of old age, are on an equal footing; or if any one poſſeſs a pre-eminence over the reſt, he owes it to ſuperior addreſs or fortitude. The whole tribe deliberate; the old give their advice; each individual of the aſſembly receives or rejects it at his pleaſure (for the whole body think not of exerciſing any compulſatory power over the will of individuals); and the warrior who is moſt diſtinguiſhed for ſtrength, addreſs, and valour, leads out the youth of the tribe to the chace or againſt the enemy. War, which in the former ſtage did not prevail, as they who were ſtrangers to ſocial ſentiments were, at the ſame time, ſcarce capable of being enemies, now firſt begins to depopulate the thinly inhabited regions where thoſe hunters and fiſhers purſue their prey. They are ſcattered, poſſibly in ſcanty and ſeparate tribes, over an immenſe tract of country; but they know no medium between the affection which brethren of the ſame tribe bear to each other and the hatred of enemies. Though thinly ſcattered over the earth, yet the hunting parties of different tribes will ſometimes meet as they range the foreſts; and when they meet, they will naturally view each other with a jealous eye; for the ſucceſs of the one party in the chace may cauſe the other to be unſucceſsful; and while the one ſnatches the prey, the other muſt return home to all the pangs of famine. Inveterate hoſtility will therefore long prevail among neighbouring tribes in the hunting ſtate.

If we find them not incapable of ſocial order, we may naturally expect that their conduct will be influenced by ſome ſentiments of religion. They have at this period ideas of ſuperior beings. They alſo practiſe certain ceremonies to recommend them to thoſe beings; but both their ſentiments and ceremonies are ſuperſtitious and abſurd.

We have elſewhere ſhown (ſee POLYTHEISM) how ſavage tribes have probably degenerated from the pure worſhip of the one true God to the adoration of a multitude of imaginary divinities in heaven, earth, and hell. We have traced this idolatrous worſhip from that of the heavenly bodies, through all the gradations of dæmon-worſhip, hero-worſhip, and ſtatue-worſhip, to that wonderful inſtance of abſurd ſuperſtition which induced the inhabitants of ſome countries to fall proſtrate in adoration before the vileſt reptiles. But though we are convinced that the heavenly bodies have by all idolaters been conſidered as their firſt and greateſt gods, we pretend not that the progreſs through the other ſtages of polytheiſm has been everywhere in the very ſame order. It is indeed impoſſible to exhibit under one general view an account of arts, manners, and religious ſentiments, which may apply to ſome certain period in the hiſtory of every nation, The characters and circumſtances of nations are ſcarce leſs various and anomalous than thoſe of individuals. Among many of the American tribes among the ancient inhabitants of the foreſts of Germany, whoſe manners have been ſo accurately delineated by the maſterly pen of Tacitus, and in ſome of the iſlands ſcattered over the ſouthern ocean, religion, arts, and government, have been found in that ſtate which we have deſcribed as characterizing the ſecond ſtage of ſocial life. But neither can we pretend that all thoſe ſimple and rude ſocieties have been deſcribed by hiſtorians and travellers as agreeing preciſely in their arts, manners, and religious ſentiments; or that the difference of circumſtances always enables us to account in a ſatisfactory manner for the diſtinction of their characters. There is a variety of facts in the hiſtory of the early periods of ſociety, which no ingenuity, no induſtry however painful, can reduce under general heads. Here, as well as when we attempt to philoſophize on the phenomena of the material world, we find reaſon to confeſs that our powers are weak, and our obſervation confined within a narrow ſphere. Society.

11
Third ſtage in the progreſs of ſociety, in which ideas of property and inequality of ranks appear.

But we may now carry our views a little forward, and ſurvey human life as approaching ſomewhat nearer to a civilized and enlightened ſtate. As property is acquired, inequality and ſubordination of ranks neceſſarily follow: and when men are no longer equal, the many are ſoon ſubjected to the will of the few. But what gives riſe to theſe new phenomena is, that after having often ſuffered from the precarioufneſs of the hunting and fiſhing ſtate, men begin to extend their cares beyond the preſent moment, and to think of providing ſome ſupply for future wants. When they are enabled to provide ſuch a ſupply, either by purſuing the chace with new eagerneſs and perſeverance, by gathering the ſpontaneous fruits of the earth, or by breeding tame animals—theſe acquiſitions are at firſt the property of the whole ſociety, and diſtributed from a common ſtore to each individual according to his wants: But as various reaſons will ſoon concur to convince the community, that by this mode of diſtribution, induſtry and activity are treated with injuſtice, while negligence and indolence receive more than their due, each individual will in a ſhort time become his own ſteward, and a community of goods will be aboliſhed. As ſoon as diſtinct ideas of property are formed, it muſt be unequally diſtributed; and as ſoon as property is unequally diſtributed, there ariſes an inequality of ranks. Here we have the origin of the depreſſion of the female ſex in rude ages, of the tyrannical authority exerciſed by parents over their children, and perhaps of ſlavery. The women cannot diſplay the ſame perſeverance, or activity, or addreſs, as the men in purſuing the chace. They are therefore left at home; and from that moment are no longer equals, but ſlaves and dependants, who muſt ſubſiſt by the bounty of the males, and muſt therefore ſubmit with implicit obedience to all their capricious commands. Even before the era of property, the female ſex were viewed as inferiors; but till that period they were not reduced to a ſtate of abject ſlavery.

In this period of ſociety new notions are formed of the relative duties. Men now become citizens, maſters, and ſervants; huſbands, parents, &c. It is impoſſible to enumerate all the various modes of government which take place among the tribes who have advanced

Society. to this ſtage; but one thing certain is, that the authority of the few over the many is now firſt eſtabliſhed, and that the riſe of property firſt introduces inequality of ranks. In one place, we ſhall perhaps find the community ſubjected during this period to the will of a ſingle perſon; in another, power may be lodged in the hands of a number of chiefs; and in a third, every individual may have a voice in creating public officers, and in enacting laws for the ſupport of public order. But as no code of laws is formed during this period, juſtice is not very impartially adminiſtered, nor are the rights of individuals very faithfully guarded. Many actions, which will afterwards be conſidered as heinouſly immoral, are now conſidered as praiſe-worthy or indifferent. This is the age of hero-worſhip, and of houſehold and tutelary gods; for it is in this ſtage of ſociety that the invention of arts, which gave riſe to that worſhip, contributes moſt conſpicuouſly to the public good. War, too, which we conſidered as beginning firſt to ravage the earth during the former period, and which is another cauſe of the deification of dead men, will ſtill prevail in this age, and be carried on with no leſs ferocity than before, though in a more ſyſtematic form.

The prevalence of war, and the means by which ſubſiſtence is procured, cannot but have conſiderable influence on the character and ſentiments of ſocieties and individuals. The hunter and the warrior are characters in many reſpects different from the ſhepherd and the huſbandman. Such, in point of government, arts, and manners, religious and moral ſentiments, were ſeveral of the German tribes deſcribed by Tacitus; and the Britons whoſe character has been ſketched by the pen of Cæſar: ſuch, too, were the Romans in the early period of their hiſtory; ſuch too the inhabitants of Aſia Minor about the time of the ſiege of Troy, as well as the Greeks whom Homer celebrates as the deſtroyers of the Trojan ſtate: the northern tribes alſo, who poured thro' Aſia, Africa, and Europe, and overthrew the Roman empire, appear to have been of a nearly ſimilar character. It ſeems to be a general opinion among thoſe who have directed their attention to the hiſtory of ſociety, that, in the ſcale aſcending from the loweſt condition of human beings to the moſt civilized and enlightened ſtate of ſociety, the ſhepherd ſtate is the next in order above the hunting; and that as mankind improve in knowledge and in moral ſentiments, and as the foreſts are gradually depopulated of their inhabitants, inſtead of deſtroying the inferior animals, men become their guardians and protectors. But we cannot unreſervedly ſubſcribe to this opinion: we believe, that in the ſhepherd ſtate ſocieties have been ſometimes found ſuperior to the moſt poliſhed tribes of hunters; but upon viewing the annals of mankind in early ages, we obſerve that there is often no inconſiderable reſemblance even between hunters and ſhepherds in point of the improvement of the rational faculties and the moral ſenſe; and we are therefore led to think, that theſe two ſtates are ſometimes parallel: for inſtance, ſeveral of the American tribes, who ſtill procure their ſubſiſtence by hunting, appear to be nearly in the ſtate which we have deſcribed as the third ſtage in the progreſs of ſociety; and the ancient ſhepherds of Aſia do not appear to have been much more cultivated and refined. We even believe that men have ſometimes turned their attention from hunting to agriculture without paſſing through any intermediate ſtate. Let us remember, that much depends upon local circumſtances, and ſomewhat undoubtedly on original inſpiration and traditionary inſtruction. In this period of ſociety the ſtate of the arts well deſerves our attention. We ſhall find, that the ſhepherds and the hunters are in that reſpect on a pretty equal footing. Whether we examine the records of ancient hiſtory, or view the iſlands ſcattered through the South Sea, or range the wilds of America, or ſurvey the ſnowy waſtes of Lapland and the frozen coaſt of Greenland—ſtill we find the uſeful arts in this period, though known and cultivated, in a very rude ſtate; and the fine arts, or ſuch as are cultivated merely to pleaſe the fancy or to gratify caprice, diſplaying an odd and fantaſtic, not a true or natural, taſte; yet this is the period in which eloquence ſhines with the trueſt luſtre: all is metaphor or glowing ſentiment. Languages are not yet copious; and therefore ſpeech is figurative, expreſſive, and forcible. The tones and geſtures of nature, not being yet laid aſide, as they generally are, from regard to decorum, in more poliſhed ages, give a degree of force and expreſſion to the harangues of the ruſtic or ſavage orator, which the moſt laborious ſtudy of the rules of rhetoric and elocution could not enable even a more poliſhed orator to diſplay. Society.

12 Fourth ſtage; in which agriculture flouriſhes, the arts are ſubdivided, commerce and regular government are introduced.

But let us advance a little farther, and contemplate our ſpecies in a new light, where they will appear with greater dignity and amiableneſs of character. Let us view them as huſbandmen, artizans, and legiſlators. Whatever circumſtances might turn the attention of any people from hunting to agriculture, or cauſe the herdſman to yoke his oxen for the cultivation of the ground, certain it is that this change in the occupation would produce an happy change on the character and circumſtances of men; it would oblige them to exert a more regular and perſevering induſtry. The hunter is like one of thoſe birds that are deſcribed as paſſing the winter in a torpid ſtate. The ſhepherd's life is extremely indolent. Neither of theſe is very favourable to refinement. But different is the condition of the huſbandman. His labours ſucceed each other in regular rotation through the year. Each ſeaſon with him has its proper employments: he therefore muſt exert active perſevering induſtry; and in this ſtate we often find the virtues of rude and poliſhed ages united. This is the period where barbariſm ends and civilization begins. Nations have exiſted for ages in the hunting or the ſhepherd ſtate, fixed as by a kind of ſtagnation, without advancing farther. But ſcarce any inſtances occur in the hiſtory of mankind of thoſe who once reached the ſtate of huſbandmen, remaining long in that condition without riſing to a more civilized and poliſhed ſtate. Where a people turn their attention in any conſiderable degree to the objects of agriculture, a diſtinction of occupations naturally ariſes among them. The huſbandman is ſo cloſely employed thro' the ſeveral ſeaſons of the year in the labours of the field, that he has no longer leiſure to exerciſe all the rude arts known among his countrymen. He has not time to faſhion the inſtruments of huſbandry, to prepare his clothes, to build his houſe, to manufacture houſehold utenſils, or to tend thoſe tame animals which he continues to rear. Thoſe different departments therefore now begin to employ different perſons; each of whom

Society. dedicates his whole time and attention to his own occupation. The manufacture of cloth is for a conſiderable time managed excluſively by the women; but ſmiths and joiners ariſe from among the men. Metals begin now to be conſidered as valuable materials. The intercourſe of mankind is now placed on a new footing. Before, every individual practiſed all the arts that were known, as far as was neceſſary for ſupplying himſelf with the conveniences of life. Now he confines himſelf to one or to a few of them; and, in order to obtain a neceſſary ſupply of the productions of thoſe arts which he does not cultivate himſelf, he gives in exchange a part of the productions of his own labours. Here we have the origin of commerce.

After continuing perhaps for ſome time in this ſtate, as arts and diſtinctions multiply in ſociety, the exchange of one commodity for another is found troubleſome and inconvenient. It is ingeniouſly contrived to adopt a medium of commerce, which being eſtimated not by its intrinſic value, but by a certain nominal value which it receives from the agreement of the ſociety among whom it is uſed, ſerves to render the exchange of property, which is ſo neceſſary for the purpoſes of ſocial life, eaſy and expeditious. Wherever metals have been known, they appear to have been adopted as the medium of commerce almoſt as ſoon as ſuch a medium began to be uſed: and this is one important purpoſe for which they ſerve; but they have ſtill more important uſes. Almoſt all the neceſſary arts depend on them. Where the metals are known, agriculture practiſed, and the neceſſary arts diſtributed among different orders of artiſans—civilization and refinement, if not obſtructed by ſome accidental circumſtances, advance with a rapid progreſs. With regard to the firſt applying of the precious metals as the medium of commerce, we may obſerve, that this was probably not accompliſhed by means of a formal contract. They might be firſt uſed as ornaments; and the love of ornament, which prevails among rude as much as among civilized nations, would render every one willing to receive them in exchange for ſuch articles as he could ſpare. Such might be the change produced on ſociety with regard to the neceſſary arts by the origin of agriculture. As ſoon as ornament and amuſement are thought of, the fine arts begin to be cultivated. In their origin therefore they are not long poſterior to the neceſſary and uſeful arts. They appear long before men reach the comfortable and reſpectable condition of huſbandmen; but ſo rude is their character at their firſt origin, that our *Dilettanti* would probably view their productions of that period with unſpeakable contempt and diſguſt. But in the period of ſociety which we now conſider, they have aſpired to an higher character; yet poetry is now perhaps leſs generally cultivated than during the ſhepherd ſtate. Agriculture, conſidered by itſelf, is not directly favourable either to refinement of manners or to the fine arts. The converſation of ſhepherds is generally ſuppoſed to be far more elegant than that of huſbandmen; but though the direct and immediate effects of this condition of life be not favourable to the fine arts, yet indirectly it has a ſtrong tendency to promote their improvement. Its immediate influence is extremely favourable to the neceſſary and uſeful arts; and theſe are no leſs favourable to the fine arts.

Society. One of the nobleſt changes which the introduction of the arts by agriculture produces on the form and circumſtances of ſociety, is the introduction of regular government and laws. In tracing the hiſtory of ancient nations, we ſcarce ever find laws introduced at an earlier period. Minos, Solon, and Lycurgus, do not appear to have formed codes of wiſdom and juſtice for regulating the manners of their countrymen, till after the Cretans, the Athenians, and even the Lacedemoniats, had made ſome progreſs in agriculture and the uſeful arts.

Religion, under all its various forms, has in every ſtage of ſociety a mighty influence on the ſentiments and conduct of men (ſee RELIGION); and the arts cultivated in ſociety have on the other hand ſome influence on the ſyſtem of religious belief. One happy effect which will reſult from the invention of arts, though perhaps not immediately, will be, to render the character of the deities more benevolent and amiable, and the rites of their worſhip more mild and humane.

The female ſex in this period generally find the yoke of their ſlavery ſomewhat lightened. Men now become eaſier in their circumſtances; the ſocial affections aſſume ſtronger influence over the mind; plenty, and ſecurity, and eaſe, at once communicate both delicacy and keenneſs to the ſenſual deſires. All theſe circumſtances concur to make men relax in ſome degree that tyrannic ſway by which they before depreſſed the ſofter ſex. The foundation of that empire, where beauty triumphs over both wiſdom and ſtrength, now begins to be laid. Such are the effects which hiſtory warrants us to attribute to agriculture and the arts; and ſuch the outlines of the character of that which we reckon the fourth ſtage in the progreſs of ſociety from rudeneſs to refinement.

13 Fifth ſtage in the progreſs of ſociety; in which literature, arts, and ſciences, are much cultivated, and religion aſſumes a mild and engaging aſpect.

Let us advance one ſtep farther. We have not yet ſurveyed mankind in their moſt poliſhed and cultivated ſtate. Society is rude at the period when the arts firſt *begin* to ſhow themſelves, in compariſon of that ſtate to which it is raiſed by the induſtrious cultivation of them. The neighbouring commonwealths of Athens and Lacedemon afford us a happy opportunity of comparing this with the former ſtage in the progreſs of ſociety. The chief effect produced by the inſtitutions of Lycurgus ſeems to have been, to fix the manners of his countrymen for a conſiderable period in that ſtate to which they had attained in his days. Spartan virtue has been admired and extolled in the language of enthuſiaſm; but in the ſame manner has the character and the condition of the ſavage inhabitants of the wilds of America, been preferred by ſome philoſophers, to the virtues and the enjoyments of ſocial life in the moſt poliſhed and enlightened ſtate. The Spartans in the days of Lycurgus had begun to cultivate the ground, and were not unacquainted with the uſeful arts. They muſt ſoon have advanced farther had not Lycurgus ariſen, and by effecting the eſtabliſhment of a code of laws, the tendency of which appears to have been in many particulars directly oppoſite to the deſigns of nature, retarded their progreſs towards complete civilization and refinement. The hiſtory of the Lacedemonians, therefore, while the laws of Lycurgus continued in force, exhibits the manners and character of a people in that which we have denominated the fourth ſtage in the progreſs of ſociety. But if we turn our eyes to their neigh-

Society. neighbours the Athenians, we behold in their hiſtory the natural progreſs of opinions, arts, and manners. The uſeful arts are firſt cultivated with ſuch ſteady induſtry, as to raiſe the community to opulence, and to furniſh them with articles for commerce with foreign nations. The uſeful arts cannot be raiſed to this height of improvement without leading men to the purſuit of ſcience. Commerce with foreign nations, ſkill in the uſeful arts, and a taſte for ſcience, mutually aid each other, and conſpire to promote the improvement of the fine arts. Hence magnificent buildings, noble ſtatues, paintings expreſſive of life, action, and paſſion; and poems in which imagination adds new grace and ſublimity to nature, and gives the appearances of ſocial life more irreſiſtible power over the affections of the heart. Hence are moral diſtinctions more carefully ſtudied, and the rights of every individual and every order in ſociety better underſtood and more accurately defined. Moral ſcience is generally the firſt ſcientific purſuit which ſtrongly attracts the attention of men. Lawgivers appear before geometricians and aſtronomers. Some particular circumſtances may cauſe theſe ſciences to be cultivated at a very early period. In Egypt the overflowing of the Nile cauſed geometry to be early cultivated. Cauſes no leſs favourable to the ſtudy of aſtronomy, concurred to recommend that ſcience to the attention of the Chaldeans long before they had attained the height of refinement. But, in general, we find, that the laws of morality are underſtood, and the principles of morals inquired into, before men make any conſiderable progreſs in phyſical ſcience, or even proſecute it with any degree of keenneſs. Accordingly, when we view the ſtate of literature in this period (for it is now become an object of ſo much importance as to force itſelf on our attention), we perceive that poetry, hiſtory, and morals, are the branches chiefly cultivated. Arts are generally caſual inventions, and long practiſed before rules and principles on which they are founded aſſume the form of ſcience. But morality, if conſidered as an art, is that art which men have ſooneſt and moſt conſtantly occaſion to practiſe. Beſides, we are ſo conſtituted by the wiſdom of nature, that human actions, and the events which befal human beings, have more powerful influence than any other object to engage and fix our attention. Hence we are enabled to explain why morality, and thoſe branches of literature more immediately connected with it, are almoſt always cultivated in preference to phyſical ſcience. Though poetry, hiſtory, and morals, be purſued with no ſmall eagerneſs and ſucceſs in that period of ſociety which we now conſider, we need not therefore be greatly ſurpriſed that natural philoſophy is neither very generally nor very ſucceſsfully cultivated. Were we to conſider each particular in that happy change which is now produced on the circumſtances of mankind, we ſhould be led into a too minute and perhaps unimportant detail. This is the period when human virtue and human abilities ſhine with moſt ſplendour. Rudeneſs, ferocity, and barbariſm, are now baniſhed. Luxury has made her appearance; but as yet ſhe is the friend and the benefactreſs of ſociety. Commerce has ſtimulated and rewarded induſtry, but has not yet contracted the heart and debaſed the character. Wealth is not yet become the ſole object of purſuit. The charms of ſocial intercourſe are known and reliſhed; but domeſtic duties are not yet deſerted for public amuſements. The female ſex acquire new Society. influence, and contribute much to refine and poliſh the manners of their lords. Religion now aſſumes a milder and more pleaſing form; ſplendid rites, magnificent temples, pompous ſacrifices, and gay feſtivals, give even ſuperſtition an influence favourable to the happineſs of mankind. The gloomy notions and barbarous rites of former periods fall into diſuſe. The ſyſtem of theology produced in former ages ſtill remains: but only the mild and amiable qualities of the deities are celebrated; and none but the gay, humane, and laughing divinities, are worſhipped. Philoſophy alſo teaches men to diſcard ſuch parts of their religion as are unfriendly to good morals, and have any tendency to call forth or cheriſh unſocial ſentiments in the heart. War (for in this period of ſociety enough of cauſes will ariſe to arm one nation againſt another)—war, however, no longer retains its former ferocity; nations no longer ſtrive to extirpate one another; to procure redreſs for real or imaginary injuries; to humble, not to deſtroy, is now its object. Priſoners are no longer murdered in cold blood, ſubjected to horrid and excruciating tortures, or condemned to hopeleſs ſlavery. They are ranſomed or exchanged; they return to their country, and again fight under its banners. In this period the arts of government are likewiſe better underſtood, and practiſed ſo as to contribute moſt to the intereſts of ſociety. Whether monarchy, or democracy, or ariſtocracy, be the eſtabliſhed form, the rights of individuals and of ſociety are in general reſpected. The intereſts of ſociety are ſo well underſtood, that the few, in order to preſerve their influence over the many, find it neceſſary to act rather as the faithful ſervants than the imperious lords of the public. Though the liberties of a nation in this ſtate be not accurately defined by law, nor their property guaranteed to them by any legal inſtitutions, yet their governors dare not violate their liberties, nor deprive them wantonly of their properties. This is truly the golden age of ſociety: every trace of barbariſm is entirely effaced; and vicious luxury has not yet begun to ſap the virtue and the happineſs of the community. Men live not in liſtleſs indolence; but the induſtry in which they are engaged is not of ſuch a nature as to overpower their ſtrength or exhauſt their ſpirits. The ſocial affections have now the ſtrongeſt influence on mens ſentiments and conduct.

14 Degeneracy and decline of ſociety.

But human affairs are ſcarce ever ſtationary. The circumſtances of mankind are almoſt always changing, either growing better or worſe. Their manners are ever in the ſame fluctuating ſtate. They either advance towards perfection or degenerate. Scarce have they attained that happy period in which we have juſt contemplated them, when they begin to decline till they perhaps fall back into a ſtate nearly as low as that from which we ſuppoſe them to have emerged. Inſtances of this unhappy degeneracy occur more than once in the hiſtory of mankind; and we may finiſh this ſhort ſketch of the hiſtory of ſociety by mentioning in what manner this degeneracy takes place. Perhaps, ſtrictly ſpeaking, every thing but the ſimple neceſſaries of life may be denominated luxury: For a long time, however, the welfare of ſociety is beſt promoted, while its members aſpire after ſomething more than the mere neceſſaries of life. As long as theſe ſuperfluities are to be obtained only by active and honeſt exertion; as long

as

Society. as they only engage the leiſure hours, without becoming the chief objects of purſuit—the employment which they give to the faculties is favourable both to the virtue and the happineſs of the human race.

The period arrives, however, when luxury is no longer ſerviceable to the intereſts of nations; when ſhe is no longer a graceful, elegant, active form, but a languid, overgrown, and bloated carcaſe. It is the love of luxury, which contributed ſo much to the civilization of ſociety, that now brings on its decline. Arts are cultivated and improved, and commerce extended, till enormous opulence be acquired: the effect of opulence is to awake the fancy, to conceive ideas of new and capricious wants, and to inflame the breaſt with new deſires. Here we have the origin of that ſelfiſhneſs which, operating in conjunction with caprice and the violence of unbridled paſſions, contributes ſo much to the corruption of virtuous manners. Selfiſhneſs, caprice, indolence, effeminacy, all join to looſen the bonds of ſociety, to bring on the degeneracy both of the uſeful and the fine arts, to baniſh at once the mild and the auſtere virtues, to deſtroy civil order and ſubordination, and to introduce in their room anarchy or deſpotiſm.

Scarce could we have found an example of the beautiful form of ſociety which we laſt attempted to deſcribe. Never, at leaſt, has any nation continued long to enjoy ſuch happy circumſtances, or to diſplay ſo amiable and reſpectable a character. But when we ſpeak of the declining ſtate of ſociety, we have no difficulty in finding inſtances to which we may refer. Hiſtory tells of the Aſſyrians, the Egyptians, and the Perſians, all of them once flouriſhing nations, but brought low by luxury and an unhappy corruption of manners. The Greeks, the Romans, and the Arabians, owed their fall to the ſame cauſes; and we know not if a ſimilar fate does not now threaten many of thoſe nations who have long made a diſtinguiſhed figure in the ſyſtem of Europe. The Portugueſe, the Venetians, and the Spaniards, have already fallen; and what is the preſent ſtate of our neighbours the French? They have long been a people deſtitute of religion, corrupted in morals, unſteady in conduct, and ſlaves to pleaſure and public amuſements. Among them luxury had arrived at its higheſt pitch; and the conſequence has been, that after capriciouſly ſhaking off the yoke of deſpotiſm, they have eſtabliſhed, or rather ſet up (for eſtabliſhed it cannot be), a motely kind of government, which, in the courſe of a few years, has exhibited ſcenes of tyranny and oppreſſion, to which we doubt if the annals of the world can furniſh any parallel. Yet this is the people whoſe manners the other nations of Europe were ambitious to imitate. May thoſe nations take warning in time, and avoid the rocks upon which they have ſplit.

15 Concluding remarks. THUS have we viewed the ſeveral ſtages in which ſociety appears in its progreſs from rudeneſs to refinement and decay. The intelligent reader will perceive, that the various and anomalous phenomena which occur in the natural hiſtory of ſociety, cannot eaſily be ſolved; becauſe the neceſſary information cannot be obtained. Others have been well accounted for by the reſearches of curious philoſophical inquirers. Local circumſtances, the influence of climate, the intercourſe of nations in different ſtates of civilization, have been taken notice of, as cauſes ſerving to accelerate or retard the progreſs of arts and manners. But our proper buſineſs here was merely to mark the gradations between barbariſm and refinement: and as the painter who is to exhibit a ſeries of portraits repreſenting the human form in infancy, puerility, youth, and manhood, will not think of delineating all that variety of figures and faces which each of thoſe periods of life affords, and will find himſelf unable to repreſent in any ſingle figure all diverſities of form and features; ſo we have not once thought of deſcribing particularly under this article, all the various national characters reducible to any one of thoſe diviſions under which we have viewed the progreſs of ſociety, nor have found it poſſible to comprehend under one conſiſtent view, all the particulars which may be gathered from the remains of antiquity, from the relations of later travellers, and the general records of hiſtory concerning the progreſſive character of mankind in various regions, and under the influence of various accidents and circumſtances. This indeed would have even been improper, as all that information appears under other articles in this Work.

Societies. SOCIETIES, aſſociations voluntarily formed by a number of individuals for promoting knowledge, induſtry, or virtue. They may therefore be divided into three claſſes; ſocieties for promoting ſcience and literature, ſocieties for encouraging and promoting arts and manufactures, and ſocieties for diffuſing religion and morality and relieving diſtreſs. Societies belonging to the firſt claſs extend their attention to all the ſciences and literature in general, or devote it to one particular ſcience. The ſame obſervation may be applied to thoſe which are inſtituted for improving arts and manufactures. Thoſe of the third claſs are eſtabliſhed, either with a view to prevent crimes, as the Philanthropic Society; for the diffuſion of the Chriſtian religion among unenlightened nations, as the Society for the Propagation of the Goſpel in Foreign Parts; or for introducing arts and civilization, along with a knowledge of the Chriſtian religion, as the Sierra Leona company.

The honour of planning and inſtituting ſocieties for thoſe valuable purpoſes is due to modern times. A literary aſſociation is ſaid to have been formed in the reign of Charlemagne (ſee ACADEMY); but the plan ſeems to have been rude and defective. Several others were inſtituted in Italy in the 16th century; but from the accounts which we have ſeen of them, they ſeem to have been far inferior to thoſe which are moſt flouriſhing at preſent. The moſt enlarged idea of literary ſocieties ſeems to have originated with the great Lord Bacon, the father of modern philoſophy, who recommended to the reigning prince to inſtitute ſocieties of learned men, who ſhould give to the world from time to time a regular account of their reſearches and diſcoveries. It was the idea of this great philoſopher, that the learned world ſhould be united, as it were, into one immenſe republic; which, though conſiſting of many detached ſtates, ſhould hold a ſtrict union and preſerve a mutual intelligence with each other, in every thing that regards the common intereſt. The want of this union and intelligence he laments as one of the chief obſtacles to the advancement of ſcience; and, juſtly conſidering the inſtitution of public ſocieties, in the different countries of Europe, under the auſpices of the ſovereign, to be the beſt remedy for that defect, he has given, in his fanciful work, the New Atlantis, the delineation of a philoſophical

Societies. society on the moſt extended plan, for the improvement of all arts and ſciences; a work which, though written in the language, and tinctured with the colouring of romance, is full of the nobleſt philoſophic views. The plan of Lord Bacon, which met with little attention from the age in which he lived, was deſtined to produce its effect in a period not very diſtant. The ſcheme of a philoſophical college by Cowley is acknowledged to have had a powerful influence in procuring the eſtabliſhment of the Royal Society of London by charter from Charles II. § ; and Cowley's plan is manifeſtly copied in almoſt all its parts from that in the New Atlantis. The inſtitution of the Royal Society of London was ſoon followed by the eſtabliſhment of the Royal Academy of Sciences at Paris; and theſe two have ſerved as models to the philoſophical academies of higheſt reputation in the other kingdoms of Europe.

§ *Sprat's Hiſtory of the Royal Society*, 2d edit. P. 59.

The experience of ages has ſhown, that improvements of a public nature are beſt carried on by ſocieties of liberal and ingenious men, uniting their labours without regard to nation, ſect, or party, in one grand purſuit alike intereſting to all, whereby mutual prejudices are worn off, and a humane philoſophical ſpirit is cheriſhed. Men united together, and frequently meeting for the purpoſe of advancing the ſciences, the arts, agriculture, manufactures, and commerce, may oftentimes ſuggeſt ſuch hints to one another as may be improved to important ends: and ſuch ſocieties, by being the repoſitories of the obſervations and diſcoveries of the learned and ingenious, may from time to time furniſh the world with uſeful publications which might otherwiſe be loſt: for men of ingenuity and modeſty may not chooſe to riſk their reputation, by ſending abroad unpatronized what a learned ſociety might judge richly worthy the public eye; or perhaps their circumſtances being ſtraitened, they may not be able to defray the expence of publication. Societies inſtituted for promoting knowledge may alſo be of eminent ſervice, by exciting a ſpirit of emulation, and by enkindling thoſe ſparks of genius which otherwiſe might for ever have been concealed; and if, when poſſeſſed of funds ſufficient for the purpoſe, they reward the exertions of the induſtrious and enterpriſing with pecuniary premiums or honorary medals, many important experiments and uſeful diſcoveries will be made, from which the public may reap the higheſt advantages.

Eminent inſtances of the beneficial effects of ſuch inſtitutions we have in the Royal Academy of Sciences at Paris, the Royal Society, and the Society inſtituted for the Encouragement of Arts, Manufactures, and Commerce, in London, and many others of a ſimilar kind. Hereby a ſpirit of diſcovery and improvement has been excited among the ingenious in almoſt every nation; knowledge of various kinds, and greatly uſeful to mankind, has taken place of the dry and unintereſting ſpeculations of ſchoolmen; and bold and erroneous hypotheſis has been obliged to give way to demonſtrative experiment. In ſhort, ſince the eſtabliſhment of theſe ſocieties, ſolid learning and philoſophy have more increaſed than they had done for many centuries before.

As to thoſe ſocieties eſtabliſhed for promoting induſtry, religion and morality, and relieving diſtreſs, the deſign is laudable and excellent, and preſents a beautiful picture of the philanthropy of modern times. We are happy to find, from the minutes of ſome of theſe ſocieties, that their beneficial effects are already conſpicuous.

Religious and Humane Societies.

We will now give ſome account of the moſt eminent ſocieties; arranging them under the three claſſes into which we have divided them: I. *Religious and Humane Societies*. II. *Societies for Promoting Science and Literature*. III. *Societies for Encouraging Arts, Manufactures*, &c.

I. Religious and Humane Societies.

1. *Society for the Propagation of the Goſpel in Foreign Parts*, was inſtituted by King William III. in 1701, in order to ſecure a maintenance for an orthodox clergy, and to make other proviſions for propagating the goſpel in the plantations, colonies, and factories beyond the ſeas. To that end he incorporated the archbiſhops, ſeveral of the biſhops, and others of the nobility, gentry, and clergy, to the number of 90, into one body, which, by the name of *The Society for the Propagation of the Goſpel in Foreign Parts*, was to plead and be impleaded; to have perpetual ſucceſſion, with privilege to purchaſe L. 2000 a-year inheritance, and eſtates for lives or years, with other goods and chattels to any value. By its charter the ſociety is authoriſed to uſe a common ſeal; and to meet annually on the third Friday in February for the purpoſe of chooſing a preſident, vice-preſident, and officers for the year enſuing; and on the third Friday in every month, or oftener if there ſhould be occaſion, to tranſact buſineſs, and to depute perſons to take ſubſcriptions, and collect money contributed for the purpoſes aforeſaid; and of all moneys received and laid out, it is obliged to give account yearly to the lord-chancellor or keeper, the lord chief-juſtice of the King's-bench, the lord-chief-juſtice of the Common-pleas, or to any two of theſe magiſtrates. Of this ſociety there is a ſtanding committee at St Paul's chapter-houſe, to prepare matters for the monthly meeting, which is held at St Martin's library.

Before the incorporation of the ſociety for the propagation of the goſpel in foreign parts, there had been formed, for the promoting of Chriſtian knowledge both at home and in the colonies, a voluntary aſſociation of perſons of rank and reſpectability, who in March 1699 began to hold ſtated meetings in London for that purpoſe, regulating themſelves by the laws of the land and the canons of the church; and when the new ſociety was formed, they had already tranſmitted to America and the Weſt Indies L. 800 worth of Bibles, Books of Common Prayer, and treatiſes of practical religion, beſides ſecuring a tolerable maintenance to ſeveral clergyman on that continent. This aſſociation ſtill ſubſiſts under the denomination of *The Society for Promoting Chriſtian Knowledge*, and has been productive of much good in the cities of London and Weſtminſter; but upon the formation of the new ſociety, into which all its original members were incorporated by name, the care which the voluntary aſſociation had taken of the colonies devolved of courſe upon the incorporated ſociety; of which incorporation we believe the object has been ſometimes miſtaken, and the labours of its miſſionaries groſsly miſrepreſented. It has by many been ſuppoſed that the ſociety was incorporated for the *ſole* purpoſe of converting the ſavage Americans; and it has been much blamed for ſending miſſionaries into provinces where, in the deſpicable cant of the complainers, a *goſpel-miniſtry* was already eſtabliſhed. But an impartial view of the

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rise and progress of the American provinces, now become independent states, will show the folly and injustice of those complaints.

The English colonies in North America were in the last century formed and first peopled by religious men; who, made uneasy at home by their intolerant brethren, left the *old world* to enjoy in peace that first and chief prerogative of man, *the free worship of God according to his own conscience*. At one time PURITANS were driven across the Atlantic by the episcopal church; at another, CHURCHMEN were forced away by the presbyterians just as the revolutions of state threw the civil power into the hands of the one or the other party; and not a few members of the CHURCH OF ROME were chased to the wilds of America by the united exertions of both. It has been often observed, that people persecuted for their religion become for the most part enthusiastically attached to it; and the conduct of those colonists was in perfect harmony with this observation. Their zeal, inflamed by their violent removal to the other hemisphere, kept religion alive and active among themselves; but their poverty disabled them from supplying fuel to the flame, by making provision for a ministry to instruct their offspring. The consequence was, that the new Christian commonwealth, without the kindly assistance of its mother-country, would have been, in the words of the Roman historian, *Res unius ætatis*. Against this danger a timely aid was to be provided by the society; which, as it consisted not of fanatical members, would not intrust the important business of the mission to fanatical preachers, who, though always ready for such spiritual enterprises, are never qualified to carry them on with success.

It was therefore thought fit to assign a decent maintenance for clergymen of the church of England, who might preach the gospel to their brethren in America: and though those missionaries in general carefully avoided the conduct of those of Rome, whose principal aim is to reduce all churches under submission to the papal tyranny; yet so lately as 1765, did some of the colonies, in which the puritanic spirit of the last century characterised the church established by law, raise a hideous outcry against the society for sending a mission into their quarters, though only for the service of the dispersed members of the Episcopal church residing among them, and for the conversion of those men whom their rigid fanaticism had prejudiced against Christianity itself.

Indeed the commodity called FREETHINKING, as Bishop Warburton expresses it, was at an early period imported by the opulent and fashionable colonists. The celebrated Berkeley, who had resided some years in Rhode Island, and at his return was called upon to preach the anniversary sermon before the society, informs us, that the island where he lived was inhabited by an English colony, consisting chiefly of sectaries of many different denominations; that several of the better sort of the inhabitants of towns were accustomed to assemble themselves regularly on the Lord's day for the performance of divine worship; but that most of those who were dispersed through the colony rivalled some well bred people of other countries, in a thorough indifference for all that is sacred, being equally careless of outward worship and of inward principles. He adds, that the missionaries had done, and were continuing to do, good service in bringing those planters to a serious sense of religion. "I speak it knowingly (says he), that the ministers of the gospel, in those provinces which go by the name of New England, sent and supported at the expence of the society, have, by their sobriety of manners, discreet behaviour, and a competent degree of useful knowledge, shown themselves worthy of the choice of those who sent them" We have the honour to be acquainted with some of the missionaries sent at a later period, and have reason to believe that, down to the era of the American revolution, they had the same virtues, and were doing the same good services, which procured to their predecessors this honourable testimony from one of the greatest and the best of men. Surely such a mission deserved not to be evil spoken of by sectarists of any denomination who believe in Christ; especially as the very charter of incorporation assigns as a reason for missionaries being sent to the colonies, "that by reason of their poverty those colonies were destitute and unprovided of a MAINTENANCE for ministers and the public worship of God."

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The society, however, was incorporated for other purposes than this. It was obliged by its charter to attempt the conversion of the native Americans and the negro slaves; and we have reason to believe, that, as soon as the spiritual wants of the colonists were decently supplied, it was not inattentive to these glorious objects. Its success indeed in either pursuit has not been so great as could be wished; but it would be rash and unfair to attribute this failure to the president, vice-president, or other officers of the corporation at home. An erroneous notion, that the being baptized is inconsistent with a state of slavery, rendered the selfish colonists for a long time averse from the conversion of their negroes, and made them throw every obstacle in the way of all who made the attempt; while the difficulties of the Indian mission are such as hardly any clergyman educated in a Protestant country can be supposed able to surmount.

He who hopes successfully to preach the gospel among a tribe of savage wanderers, must have an ardent zeal and unwearied diligence; appetites subdued to all the distresses of want; and a mind superior to all the terrors of mortality. These qualities and habits may be acquired in the church of Rome by him who from infancy has been trained up in the severities of some of the monastic orders, and afterwards sent to the college *de propaganda fide* to be instructed in the languages, and inured to the manners and customs of the barbarous nations whose conversion he is destined to attempt. But in the reformed churches of Britain there are no monastic orders, nor any college *de propaganda fide*; and yet without the regular preparation, which is to be looked for in such institutions alone, it is not in nature, whatever grace may effect, for any man cheerfully, and at the same time soberly, to undergo all the accumulated distresses ever ready to overtake a faithful missionary among savage idolaters. A fanatic zealot will indeed undertake it, though he is totally unqualified for every sober and important work; and a man of ruined fortunes may be pressed into the service, though the impotency of his mind has shown him unable to bear either poverty or riches. The failure of the society therefore in its attempts to convert the American Indians may be attributed, we think, in the first instance,

† See his *Sermon*, Vol. II. of his *Works*, 4to.

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stance, to the want of a college *de propaganda* for training up young men for the American miſſion.

Perhaps another cauſe of this failure may be found in the conduct of the miſſionaries, who, it is to be preſumed, have not always employed in a proper manner even the ſcanty qualifications which they actually poſſeſſed. The goſpel, plain and ſimple as it is, and fitted in its nature for what it was ordained to effect, cannot be apprehended but by an intellect ſomewhat raiſed above that of a ſavage. Such of the miſſionaries therefore as began their work with *preaching to ſavage and brutal men*, certainly ſet out at the wrong end; for to make the goſpel underſtood, and much more to propagate and eſtabliſh it, thoſe ſavages ſhould have been firſt taught the neceſſary arts of civil life, which, while they improve every bodily accommodation, tend at the ſame time to enlarge and enlighten the underſtanding. For want of this previous culture, we doubt not, it hath happened that ſuch of the ſavages as have been baptized into the faith have ſo ſeldom perſevered themſelves, or been able in any degree to propagate among their tribes the Chriſtianity which they had been taught, and that ſucceſſive miſſions have always found it neceſſary to begin anew the work of converſion.

To one or other of theſe cauſes, or to both, may juſtly be attributed the little progreſs which reformed Chriſtianity has made among the Indians of North America; and not to any want of zeal, attention, or liberality, in the directors of the ſociety at home. During the dependence of the United States on the mother-country, great part of the ſociety's funds was properly expended in keeping alive a juſt ſenſe of religion among the Chriſtian coloniſts from Europe, who had ſurely the firſt claims upon this beſt of charities; but now that America has ſeparated herſelf from Great Britain, and ſhown that ſhe is able to maintain her independence, and to make ample proviſion for a regular clergy of her own, the members of the corporation muſt feel themſelves at liberty to beſtow greater attention, and to expend more money than they could formerly do, on the converſion of ſuch Indians as have any intercourſe with the ſettlements which we ſtill poſſeſs. To a body ſo reſpectable, we preſume not to offer advice; but we cannot help thinking, with Biſhop Berkeley, that the moſt ſucceſsful miſſionaries would be children of Indians, educated in a conſiderable number together from the age of ten or twelve in a college *de propaganda fide*, where they ſhould be in no danger of loſing their mother-tongue while they were acquiring a competent knowledge of religion, morality, hiſtory, practical mathematics, and agriculture. "If there were a yearly ſupply (ſays he) of a dozen ſuch miſſionaries ſent abroad into their reſpective countries, after they had received the degree of maſter of arts, and been admitted into holy orders, it is hardly to be doubted but that in a little time the world would ſee good and great effects of their miſſion."

Propoſal for the better ſupplying of Churches in our Foreign Plantations, &c.

2. *Society in Scotland for Propagating Chriſtian Knowledge*, was inſtituted in the beginning of the preſent century. At that period the condition of the Scotch Highlanders was truly deplorable. Shut up in deſolate iſlands by tempeſtuous ſeas, or diſperſed over a wide extent of country, interſected by high mountains, rapid rivers, and arms of the ſea, without bridges or highways, by which any communication could be kept open either with remote or neighbouring diſtricts, they lived in ſmall detached companies in hamlets or ſolitary huts. Being thus ſecluded from intercourſe with the more civilized part of the iſland, they could not enjoy the advantages of trade and manufactures. As their ſoil was barren and their climate ſevere, in agriculture no progreſs was to be expected: and as they were acquainted with no language but Gaelic, in which no books were then written, to poſſeſs knowledge was impoſſible. Their pariſhes being of great extent, often 30 or 40 miles long and of a proportionable breadth, and ſometimes conſiſting of ſeveral iſlands ſeparated by ſeas, which are often impaſſable, a conſiderable number of the inhabitants was entirely deprived of religious inſtruction or fell a prey to Popiſh emiſſaries. A ſingle ſchool in ſuch extenſive pariſhes could be of little benefit; yet many pariſhes were entirely deſtitute even of this reſource: and where ſchools were eſtabliſhed, the want of books prevented them from producing the uſeful effects otherwiſe to have been expected from them (A). To all this we muſt add, that they lived in a ſtate of the greateſt oppreſſion: For though the Highlands formed a part of the Britiſh empire, the bleſſings of the Britiſh conſtitution had not reached them. The feudal ſyſtem reigned in its utmoſt rigour; the chieftains exerciſing the moſt deſpotic ſway over the inferior Highlanders, whom at their pleaſure they deprived of their lives or property (B).

Thus the Highlanders were ignorant, oppreſſed, and uncivilized; ſlaves rather than ſubjects; and either entirely deſtitute of the advantages of the Chriſtian religion, or unqualified to improve them. Hitherto they had been unhappy and uſeleſs to themſelves and dangerous to the ſtate; for they were ready at the call of their chieftains to iſſue from their mountains, and to turn their arms againſt their lawful king and his loyal ſubjects. This character, however, aroſe from their ſituation. It was therefore impoſſible for benevolent minds to contemplate this unhappy ſituation of their countrymen without feeling a deſire to raiſe them to the dignity of rational beings, and to render them uſeful as citizens.

Accordingly, in the year 1701, ſome private gentlemen of the city of Edinburgh, who had formed themſelves into a ſociety for the reformation of manners, directed their attention to the Highlands of Scotland, and endeavoured to deviſe ſome plan for alleviating the diſtreſſes of the inhabitants. The remedy which promiſed to be moſt efficacious was, to eſtabliſh charity ſchools in different places. But as the exigency was great, it was no eaſy matter to raiſe a ſufficient fund for this

(A) Even ſo late as the year 1758, no fewer than 175 pariſhes, within the bounds of 39 preſbyteries, had no parochial ſchool. We are ſorry to add, that even in the preſent enlightened and benevolent age the complaint is not entirely removed.

(B) The feudal ſyſtem was at length aboliſhed in the year 1748 by the juriſdiction act.

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this purpoſe. They began therefore with what voluntary ſubſcriptions they could procure, hoping afterwards to increaſe their capital by vacant ſtipends and public contributions. A memorial with this view was preſented to the General Aſſembly in 1704, which received their approbation; and they accordingly paſſed an act, recommending a general contribution. In 1706 the General Aſſembly appointed ſome of their number to inquire more carefully into the ſtate of the Highlands, and the year following appointed a ſelect committee to confer with the gentlemen who had ſuggeſted the plan. The reſult of theſe conferences was the publication of propoſals, "for propagating Chriſtian knowledge in the Highlands and iſlands of Scotland, and in foreign parts of the world." Copies of theſe propoſals, with ſubſcription papers, were diſtributed through the kingdom; and the contributions having ſoon amounted to L. 1000, her majeſty Queen Anne encouraged this infant ſociety by her royal proclamation, and at the ſame time iſſued letters patent under the great ſeal of Scotland for erecting certain of the ſubſcribers into a corporation; the firſt nomination of whom was lodged with the lords of council and ſeſſion.

This corporation held its firſt meeting on Thurſday 3d November 1709. It was attended by ſeveral of the nobility, fourteen of the lords of ſeſſion, many gentlemen of rank, together with moſt of the miniſters of the city of Edinburgh and neighbourhood. A preſident, ſecretary, and treaſurer, with a committee of fifteen directors, were appointed for the diſpatch of buſineſs. At their ſecond meeting in January 1710, a ſcheme of management was formed and approved; in which it was propoſed, 1. To erect and maintain ſchools in ſuch places of Scotland, particularly in the Highlands and Iſlands, as ſhould be found to need them moſt; in which ſchools all perſons whatſoever ſhould be taught by fit and well qualified ſchoolmaſters, appointed by the ſociety, to read the Holy Scriptures and other pious books; as alſo to write, and to underſtand the common rules of arithmetic, with ſuch other things as ſhould be thought ſuitable to their circumſtances. 2. That the ſchoolmaſters ſhould be particularly careful to inſtruct their ſcholars in the principles of the Chriſtian reformed religion; and for that end ſhould be obliged to catechiſe them at leaſt twice a-week, and to pray publicly with them twice a-day. 3. That not only ſuch as were unable to pay ſhould be taught gratis, but that thoſe whoſe circumſtances required it, ſhould have ſuch farther encouragement as the ſociety ſhould think fit in a conſiſtency with their patent. 4. To name ſome prudent perſons, miniſters and others, to be overſeers of thoſe ſchools, who ſhould take care that the ſchoolmaſters do their duty, and that the inſtructions to be given from time to time by the ſociety or their committee be punctually obſerved; which overſeers ſhould make their report to the ſociety quarterly or half-yearly at fartheſt. 5. To give ſuitable encouragement to ſuch miniſters or catechiſts as ſhould be willing to contribute their aſſiſtance towards the farther inſtruction of the ſcholars remote from church, by not only catechiſing, but preaching to them; which miniſters or catechiſts ſhould take the ſame care of the other inhabitants as of the ſcholars. 6. To extend their endeavours for the advancement of the Chriſtian religion to heathen nations; and for that end to give encouragement to miniſters to preach the goſpel among them.

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Having thus formed a plan, they immediately proceeded to eſtabliſh ſchools in the moſt uſeful and economical manner; and as the capital continued to accumulate, the intereſt was faithfully applied, and the utility of the inſtitution was more extenſively diffuſed.

Until the year 1738 the attention of the ſociety had been wholly directed to the eſtabliſhment of ſchools; but their capital being then conſiderably augmented, they began to extend their views of utility much farther. The grand object of all public aſſociations ought certainly to be the promoting of religion and morality. It muſt, however, be evident to every man of reflection, that theſe can neither be propagated nor preſerved among a people without agriculture, unaccuſtomed to commerce and manufactures, and conſequently without labour or exertion. Languor and debility of mind muſt always be the companions of idleneſs. While the Highlanders roved about with arms in their hands, the latent vigour of their minds muſt often have been called forth into action; but when their arms were taken away, and themſelves confined to a domeſtic life, where there was nothing to rouſe their minds, they muſt have ſunk into indolence and inactivity. All attempts therefore to inſtruct them in religion and morality, without introducing among them ſome of the neceſſary arts of life, would probably have been unavailing. The ſociety accordingly reſolved to adopt what appeared to them the moſt effectual methods of introducing induſtry among the Highlanders. But as their patent did not extend far enough, they applied to his majeſty George II. for an enlargement of their powers; and accordingly obtained a ſecond patent, by which they are empowered, "beſides fulfilling the purpoſes of their original patent, to cauſe ſuch of the children as they ſhall think fit to be bred to huſbandry and houſewifery, to trades and manufactures, or in ſuch manual occupations as the ſociety ſhall think proper."

The objects of this ſecond patent the ſociety have not failed to purſue; and though many obſtacles and diſcouragements to their efforts occurred among a rude and barbarous people, yet their perſeverance, and the obvious utility of their plans, at length ſo far overcame the reluctance of the inhabitants, that no leſs than 94 ſchools of induſtry in various parts of the Highlands and iſlands are now upon their eſtabliſhment, at which are educated 2360 ſcholars.

The ſociety, while anxiouſly endeavouring to diffuſe a ſpirit of induſtry through the Highlands, were ſtill equally ſolicitous to promote the knowledge of the Chriſtian religion. As the Engliſh language had been the only channel by which knowledge was conveyed to them (a language which, being not uſed in converſation, was in all reſpects foreign to them), it was judged requiſite that they ſhould have the Scriptures in their vernacular tongue. The ſociety therefore firſt appointed a tranſlation of the New Teſtament to be made into Gaelic: A tranſlation was accordingly undertaken by the Rev. Mr Stewart miniſter of Killin in Perthſhire, and printed in 1767, which is ſaid to be executed with much fidelity. Of this work many thouſand copies have been diſtributed in the Highlands. The greater part of the Old Teſtament has alſo been tranſlated

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by the Rev. Dr Smith of Campbelton and others, but chiefly by the Rev. Dr Stewart of Luſs, by the appointment and at the expence of the ſociety: and as ſoon as the remaining part can be got ready, the whole will be ſold at ſo low a price as the poor may without difficulty afford. This plan the ſociety have judiciouſly choſen, in order to prevent diſcontent and murmuring; effects which the diffuſion of the Scriptures ought never to produce; but which could not poſſibly have been prevented, had the diſtribution been gratuitous, and of courſe partial.

For ſome years paſt the funds of the ſociety have rapidly accumulated, from the very liberal donations of ſeveral individuals.

Lady Glenorchy	-	L. 5,000
By a perſon unknown	-	10,000
Lord Van Vryhouven of Holland		20,000
Miſs Gray of Teaſſes	-	3,500

In conſequence of theſe great additions to their ſtock, inſinuations have been thrown out that the ſociety have become ſo wealthy as to be at a loſs for proper objects on which to beſtow their increaſed revenue. If ſuch an opinion be *ſeriouſly* entertained by any one, we muſt beg him to remember, that the ſociety have erected and endued no leſs than 323 ſchools for religion, the firſt principles of literature and induſtry, at the annual expence of L. 3214, 10 s. Sterling; and that at theſe ſeminaries are educated from 14,000 to 15,000 children; who, but for the means of inſtruction thus obtained, would in all probability be bred up in ignorance and idleneſs: That they employ 12 miſſionary miniſters and catechiſts in remote parts of the Highlands and iſlands, or among the ignorant Highlanders ſettled in the great towns of Scotland, at the annual expence of L. 296: That they beſtow a burſary or penſion of L. 15 *per annum* on each of ſix ſtudents of divinity having the Gaelic language: That they employ two miſſionary miniſters and one ſchoolmaſter among the Oneida and Stockbridge Indians of North America (being the deſtination of certain legacies bequeathed to them for that purpoſe), at the annual expence of L. 140. Such is their fixed ſcheme of annual expenditure, amounting in all to L. 3740, 10s. Sterling—a ſum it will be acknowledged of very conſiderable magnitude. The whole of their incidental expences ariſing from the Gaelic tranſlation of the Scriptures of the Old Teſtament; from annuities which they have to pay, in conſequence of ſums left them as reſiduary legatees; from land and houſe-taxes; from enabling candidates for the office of ſchoolmaſter to come to Edinburgh for examination; from furniſhing books to poor ſcholars in their various ſchools; and from removing ſchoolmaſters from one ſtation to another, is generally about L. 875, which added to the former ſum makes the whole annual expence amount to L. 4615, 10 s.

If it be inquired at what expence, in the *management* of it, this extenſive and complicated charity is annually conducted, we are authoriſed to ſay, that the treaſurer, bookholder, and clerk, are allowed each L. 25 *per annum*, the ſame ſalaries which were annexed to theſe offices from the commencement of the ſociety. The beadle or officer is allowed L. 12 *per annum*. No ſalary whatever is enjoyed by any of the other officers of the ſociety. The ſecretary, comptroller, accountant, and librarian, although ſubjected, ſome of them eſpecially, to no ſmall expence of time and labour, have no pecuniary recompenſe or emolument. Theirs are labours of love, for which they ſeek and expect no other reward than the conſciouſneſs of endeavouring to promote the beſt intereſts of mankind. The whole amount of the expence of managing the buſineſs of the ſociety, including the above ſalaries, and coals, candle, ſtationary ware, poſtages, and other incidents, exceeds not at an average L. 115 *per annum*. From this ſtatement it appears, that hitherto at leaſt the directors have been at no loſs for important objects within the proper ſphere of their inſtitution on which to beſtow their increaſed funds. They have, it is true, the diſpoſal of very conſiderable ſums for promoting the objects of the inſtitution; but they are ſo far from accumulating wealth, that every year their expenditure, notwithſtanding the late increaſe of their capital, exceeds rather than falls ſhort of their income. They have depended upon a kind Providence and a generous public to refund theſe anticipations of their revenue, and hitherto they have never been diſappointed.

Thus has the Society for Propagating Chriſtian Knowledge proceeded for almoſt a century. It was founded by the pious exertions of a few private individuals, whoſe names are unknown to the world; and its funds, by faithful and judicious management, as well as by generous contributions, have now become of ſuch magnitude, as to excite the hope that they will be productive of the moſt valuable effects. The benefits ariſing from public ſocieties, it is well known, depend entirely upon the management of their directors. If ſo, the advantages which have accrued from this ſociety intitle it to the praiſe and gratitude of the nation. While eager to increaſe the number of ſchools, the ſociety have not been inattentive to their proſperity. In the year 1771 Mr Lewis Drummond, a gentleman in whom they placed great confidence, was commiſſioned by them to viſit their ſchools, and to make an exact report of their ſtate and circumſtances. Again, in the year 1790, a commiſſion was granted to the Rev. Dr Kemp, one of the miniſters of Edinburgh and ſecretary to the ſociety, to viſit all the ſchools on their eſtabliſhment. This laborious and gratuitous taſk he accompliſhed in the courſe of four ſummers with much ability and care, and highly to the ſatisfaction of the ſociety. At his return he communicated a variety of important information reſpecting the ſtate of the Highlands and iſlands, and the means neceſſary for their improvement in religion, literature, and induſtry; an abſtract of which was publiſhed by the ſociety in appendixes to the anniverſary ſermons preached before them in the years 1789, 90, 91, and 92 (c).

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(c) It is well known, that the number of Roman Catholics in the Highlands is conſiderable; but it muſt give much pleaſure to the Proteſtant reader to be informed, that the ancient malignant ſpirit of Popery has in that diſtrict given place to mildneſs and liberality. This is chiefly owing to the gentleman who ſuperintends the prieſts in that quarter, whoſe mind is enlightened by ſcience and learning. So far from being hoſtile to the views

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The following table will exhibit at a glance the funds, eſtabliſhment, and expenditure, of the ſociety, from a few years after its commencement to the preſent time. Where the number of ſcholars is not mentioned, the defect may be ſupplied by taking an average from thoſe years where a computation has been made. Where the capital is not mentioned, it may eaſily be made out by conſidering the ſalaries as the intereſt.

A. D.	Capital.	Schools.	Scholars.
1713		12	
1715	L. 6,177	25	
1719	8,168	48	
1727	9,131	78	2757
1732	13,318	109	
1742	19,287	128	
1753	24,308	152	
1758	28,413	176	6409
1781	34,000	180	7000
	Salaries		
1793	3,080	307	12,913
1794	3,214	323	14,370

Hitherto we have taken no notice of the correſponding board which was eſtabliſhed at London ſo early as the year 1729, to receive ſubſcriptions and lay out ſums. That board indeed remained long inactive; but in 1773 its members began to co-operate more cordially with their brethren in Scotland. Since that period an annual ſermon has been preached in recommendation of the charity; and the preacher is now ſelected without any regard to the religious denomination to which he belongs; ſometimes from the church of England, ſometimes from the church of Scotland, and ſometimes from ſectaries of different perſuaſions. The meetings of the correſpondent board have been attended by many of the nobility and gentry, who have made great exertions to promote the views of the ſociety. From its preſent flouriſhing ſtate therefore, from the indefatigable exertion and laudable zeal of the managers, and from the countenance and ſupport which they have received from perſons of the firſt rank and reſpectability in the nation, the benevolent mind may look forward with much confidence and ſatisfaction to a period not very diſtant, when its beneficial effects ſhall be felt not only in the Highlands, but ſhall be communicated to the reſt of the nation. We have been thus particular in our account of the Society for Propagating Chriſtian Knowledge, becauſe we have had acceſs to the moſt authentic ſources of information, and becauſe we know it to be an inſtitution calculated to enlighten and improve a conſiderable part of the Britiſh nation.

3. *Society of the Sons of the Clergy*, was incorporated by King Charles II. in 1678, by the name of *The Governors of the Charity for Relief of the Poor Widows and Children of Clergymen.* This ſociety is under the direction and management of a preſident and vice-preſident, three treaſurers, and a court of aſſiſtants compoſed of forty members. Several hundreds of widows and children of the clergy have annually received conſiderable relief from this uſeful charity.

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4. *Society for the Sons of the Clergy of the Eſtabliſhed Church of Scotland*, was inſtituted at Edinburgh in February 1790, and was conſtituted a body corporate by his majeſty's royal charter in 1792. The ſociety, after ſeveral meetings, are of opinion, that the period in which the families of clergymen feel moſt urgently the need both of friends and of pecuniary aid, is that which commences with the introduction of the ſons either to an univerſity or to buſineſs, and terminates with their eſtabliſhment in their reſpective profeſſions; that many of the miniſters of this church, living at great diſtances from the ſeats either of univerſities or of buſineſs, poſſeſs incomes which, in the preſent ſtate of the country, are inadequate to the purpoſes of procuring for their ſons either the literary or profeſſional education which might enable them to come forward with credit and ſucceſs in the world; that the ſons of clergymen, from domeſtic tuition and example, have in genetal very advantageous means of receiving in their early years the impreſſions of virtue and honour, together with the rudiments of liberal knowledge; and that of courſe the public intereſt may be promoted, by enabling this claſs of young men to obtain their ſhare in the reſpectable ſituations of life. The views of the ſociety have been limited to the ſons only of clergymen; as they are of opinion, that within the limits which they have fixed, the field of beneficence will be ſtill very extenſive, and the claims for aid as many and as great as their funds can be ſuppoſed able to anſwer, at leaſt for many years to come. If the ſociety ſhall ever be in a ſituation to undertake more than the aids which will be neceſſary in bringing forward the ſons of the clergy, it may then be conſidered in what manner the daughters alſo may become ſharers in its bounty.

5. *Royal Humane Society*, was inſtituted in London in 1774, for the recovery of perſons drowned or otherwiſe ſuffocated. We have already given ſome account of ſocieties inſtituted in other countries with the ſame views, and have alſo copied the directions of this ſociety for the recovery of life, for which ſee the article DROWNING. We have therefore only to ſtate, that the plan of this ſociety is ſo adverſe to any private intereſted views, that it acquits its founders of all ſordid motives. For the medical practitioners accept no pecuniary recompenſe for the time which they devote to a difficult and tedious proceſs; for the anxiety which they feel while the event is doubtful; for the mortification which they too often undergo, when death, in ſpite of all their efforts, at laſt carries off his prey; nor for the inſults to which they willingly expoſe themſelves from vulgar incredulity. Their ſole reward is in the holy joy of doing good. Of an inſtitution thus free in its origin from the ſuſpicion of ambitious views, and in its plan renouncing ſelf-intereſt in every ſhape, philanthropy muſt be the only baſis. The good intention therefore of the ſociety is proved by its conſtitution; the

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views of the ſociety, he recommended to his clergy to promote them. They accordingly received the ſecretary with much politeneſs; exhorted the people to ſend their children to the Proteſtant ſchools to be inſtructed in literature, to be taught to read the Scriptures in their own language, and to be made acquainted with thoſe great principles of religion in which all Chriſtians are agreed. What a bleſſed reformation!

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the wiſdom and utility of the undertaking are proved by its ſucceſs: not leſs than 3000 fellow-creatures having ſince its commencement been (1794) reſtored to the community by its timely and indefatigable exertions. For it is to be obſerved, that the benefit of this ſociety is by no means confined to the two caſes of drowning and ſuſpenſion. Its timely ſuccours have rouſed the lethargy of opium taken in immoderate and repeated doſes; they have reſcued the wretched victims of intoxication; rekindled the life extinguiſhed by the ſudden ſtroke of lightning; recovered the apoplectic; reſtored life to the infant that had loſt it in the birth; they have proved efficacious in caſes of accidental ſmothering and of ſuffocation by noxious damps; in inſtances in which the tenderneſs of the infant body or the debility of old age greatly leſſened the previous probability of ſucceſs; inſomuch that no ſpecies of death ſeems to be placed beyond the reach of this ſociety's aſſiſtance, where the miſchief had gone no farther than an obſtruction of the movements of the animal machine without any damage of the organs themſelves. In conſequence of every neceſſary aſſiſtance afforded by this ſociety, ſimilar inſtitutions have been eſtabliſhed at Algiers, Liſbon, Philadelphia, Boſton, Jamaica, Dublin, Leith, Glaſgow, Aberdeen, Birmingham, Glouceſter, Shropſhire, Northamptonſhire, Lancaſter, Briſtol, Whitehaven, Norwich, Exeter, Kent, and Newcaſtle. The ſociety has publiſhed an 8vo volume with plates, conſiſting of caſes, correſpondence, and a variety of intereſting matter relating to the object of this benevolent inſtitution.

6. *The Philanthropic Society*, was inſtituted in September 1788. It aims at the prevention of crimes, by removing out of the way of evil counſel, and evil company, thoſe children who are, in the preſent ſtate of things, deſtined to ruin. It propoſes to educate and inſtruct in ſome uſeful trade or occupation the children of convicts or other infant poor who are engaged in vagrant or criminal courſes; thus to break the chain of thoſe pernicious confederacies, deprive the wicked of ſucceſſors, the gaols of inhabitants, juſtice of its victims, and by all theſe means add citizens to ſociety. This inſtitution is not only calculated to decreaſe vice and infamy, but to increaſe uſeful induſtry; ſo that thoſe children who would otherwiſe ſucceed to their parents hereditary crimes, and become the next race of beggars and thieves, will now be taught to ſupply by honeſt means their own wants and the wants of others.

To carry into effect theſe deſirable purpoſes, it is the firſt buſineſs of the ſociety to ſelect from priſons, and from the haunts of vice, profligacy, and beggary, ſuch objects as appear moſt likely to become obnoxious to the laws, or prejudicial to the community; and, in the execution of this duty, the aſſiſtance of the magiſtrates, the clergy, and all who are intereſted in the promotion of good morals and good government, is moſt earneſtly requeſted. For the employment of the children, ſeveral houſes are ſupported, at Cambridge Heath, near Hackney, in each of which a maſter-workman is placed for the purpoſe of teaching the children ſome uſeful trade. The trades already eſtabliſhed are thoſe of a printer, carpenter, ſhoemaker, and taylor. The girls are at preſent educated as menial ſervants.

In the year 1791 no leſs than 70 children were under the protection of this ſociety, among whom were many who have been guilty of various felonies, burglaries, and other crimes. Yet, ſingular as it may appear, in leſs than two years thoſe very children became no leſs remarkable for induſtry, activity, decency, and obedience, than they formerly were for the contrary vices. Such are the grounds on which the Philanthropic Society now claims the attention and ſolicits the patronage of the public. If we regard humanity and religion, this inſtitution opens an aſylum to the moſt forlorn and abject of the human race; it befriends the moſt friendleſs; it ſaves from the certain and fatal conſequences of infamy and vicious courſes orphans and deſerted children. If we regard national proſperity and the public welfare, it is calculated to increaſe induſtry; and it directs that induſtry into the moſt uſeful and neceſſary channels. If we regard ſelf-intereſt, its immediate object is to protect our perſons from aſſault and murder, our property from depredation, and our peaceful habitations from the deſperate fury of midnight incendiaries.

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One guinea *per annum* conſtitutes a member of the ſociety; and L. 10 at one payment a member for life. A life-ſubſcription, or an annual payment of at leaſt two guineas, is a neceſſary qualification for being elected into the committee.

II. Societies for Promoting Science and Literature.

1. *The Royal Society of London* is an academy or body of perſons of eminent learning, inſtituted by Charles II. for the promoting of natural knowledge. The origin of this ſociety is traced by Dr Sprat, its earlieſt hiſtorian, no farther back than to "ſome ſpace after the end of the civil wars" in the laſt century. The ſcene of the firſt meetings of the learned men who laid the foundation of it, is by him fixed in the univerſity of Oxford at the lodgings of Dr Wilkins warden of Wadham college. But Dr Birch, on the authority of Dr Wallis, one of its earlieſt and moſt conſiderable members, aſſigns it an earlier origin. According to him, certain worthy perſons, reſiding in London about the year 1645, being "inquiſitive into natural and the new and experimental philoſophy, agreed to meet weekly on a certain day, to diſcourſe upon ſuch ſubjects, and were known by the title of *The Inviſible* or *Philoſophical College*." In the years 1648 and 1649, the company who formed theſe meetings were divided, part retiring to Oxford and part remaining in London; but they continued the ſame purſuits as when united, correſponding with each other, and giving a mutual account of their reſpective diſcoveries. About the year 1659 the greater part of the Oxford ſociety returned to London, and again uniting with their fellow-labourers, met once, if not twice, a-week at Greſham college, during term time, till they were ſcattered by the public diſtractions of that year, and the place of their meeting made a quarter for ſoldiers. On the reſtoration 1660 their meetings were revived, and attended by a greater concourſe of men eminent for their rank and learning. They were at laſt taken notice of by the king, who having himſelf a conſiderable taſte for phyſical ſcience, was pleaſed to grant them an ample charter, dated the 15th of July 1662, and afterwards a ſecond dated 15th April 1763, by which they were erected into a corporation,

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ration, conſiſting of a preſident, council, and fellows, for promoting natural knowledge; and to give their inveſtigations, againſt which ſtrange prejudices were entertained, every poſſible ſupport, he ſometimes honoured their meetings with his preſence.

Their manner of electing fellows is by balloting. Their council are in number 21, including the preſident, vice-preſident, treaſurer, and two ſecretaries; 11 of which are continued for the next year, and 10 more added to them; all choſen on St Andrew's day. Each member at his admiſſion ſubſcribes an engagement that he will endeavour to promote the good of the ſociety; from which he may be freed at any time, by ſignifying to the preſident that he deſires to withdraw. The charges have been different at different times, and were at firſt irregularly paid; but they are now five guineas paid to the treaſurer at admiſſion; and 13 s. per quarter ſo long as the perſon continues a member: or, in lieu of the annual ſubſcription, a compoſition of 25 guineas in one payment.

Their deſign is, to "make faithful records of all the works of nature or art which come within their reach; ſo that the preſent as well as future ages may be enabled to put a mark on errors which have been ſtrengthened by long preſcription; to reſtore truths that have been neglected; to puſh thoſe already known to more various uſes; to make the way more paſſable to what remains unrevealed," &c. To this purpoſe they have made a great number of experiments and obſervations on moſt of the works of nature; and alſo numbers of ſhort hiſtories of nature, arts, manufactures, uſeful engines, contrivances, &c. The ſervices which they have rendered to the public are very great. They have improved naval, civil, and military architecture; advanced the ſecurity and perfection of navigation; improved agriculture; and put not only this kingdom, but alſo Ireland, the plantations, &c. upon planting. They have regiſtered experiments, hiſtories, relations, obſervations, &c. and reduced them into one common ſtock; and have, from time to time, publiſhed thoſe which they reckoned moſt uſeful, under the title of *Philoſophical Tranſactions*, &c. and laid the reſt up in public regiſters, to be nakedly tranſmitted to poſterity, as a ſolid groundwork for future ſyſtems.

They have a library adapted to their inſtitution; towards which Mr Henry Howard, afterwards duke of Norfolk, contributed the Norfolcian library, and which is, at this time, greatly increaſed by a continual ſeries of beneſactions. The muſeum or repoſitory of natural and artificial rarities, given them by Daniel Colwal, Eſq; and ſince enriched by many others, is now removed to the Britiſh muſeum, and makes a part of that great repoſitory. Their motto is *Nullius in verba*; and their place of aſſembling is Somerſet-houſe in the Strand. Sir Godfrey Copley, baronet, left five guineas to be given annually to the perſon who ſhould write the beſt paper in the year, under the head of experimental philoſophy. This reward, which is now changed to a gold medal, is the higheſt honour the ſociety can beſtow. It is conferred on St Andrew's day.

2. *The Royal Society of Edinburgh*, was incorporated by royal charter on the 29th of March 1783, and has for its object the cultivation of every branch of ſcience, erudition, and taſte. Its riſe and progreſs towards its preſent ſtate was as follows: In the year 1718 a literary ſociety was eſtabliſhed in Edinburgh by the learned Ruddiman and others, which in 1731 was ſucceeded by a ſociety inſtituted for the improvement of medical knowledge. In the year 1739 the celebrated Maclaurin conceived the idea of enlarging the plan of this ſociety, by extending it to ſubjects of philoſophy and literature. The inſtitution was accordingly new-modelled by a printed ſet of laws and regulations, the number of members was increaſed, and they were diſtinguiſhed from that time by the title of *The Society for Improving Arts and Sciences*, or more generally by the title of *The Philoſophical Society of Edinburgh*. Its meetings, however, were ſoon interrupted by the diſorders of the country during the rebellion in 1745; and they were not renewed till the year 1752. Soon after this period the firſt volume of the Tranſactions of the Philoſophical Society of Edinburgh was publiſhed, under the title of *Eſſays and Obſervations, Phyſical and Literary*, and was followed by other volumes of acknowledged merit. About the end of the year 1782, in a meeting of the profeſſors of the univerſity of Edinburgh, many of whom were likewiſe members of the Philoſophical Society, and warmly attached to its intereſts, a ſcheme was propoſed by the Rev. Dr Robertſon, principal of the univerſity, for the eſtabliſhment of a new ſociety on a more extended plan, and after the model of ſome of the foreign academies. It appeared an expedient meaſure to ſolicit the royal patronage to an inſtitution of this nature, which promiſed to be of national importance, and to requeſt an eſtabliſhment by charter from the crown. The plan was approved and adopted; and the Philoſophical Society, joining its influence as a body in ſeconding the application from the univerſity, his majeſty, as we have already obſerved, was moſt graciouſly pleaſed to incorporate The Royal Society of Edinburgh by charter.

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This ſociety conſiſts of ordinary and honorary members; and the honorary places are reſtricted to perſons reſiding out of Great Britain and Ireland. The election of new members is appointed to be made at two ſtated general meetings, which are to be held on the fourth Monday of January and the fourth Monday of June. A candidate for the place of an ordinary member muſt ſignify by a letter, addreſſed to one of the members, his wiſh to be received into the ſociety. He muſt then be publicly propoſed at leaſt a month before the day of election. If the propoſal be ſeconded by two of the members preſent, his name is to be inſerted in the liſt of candidates, and hung up in the ordinary place of meeting. The election is made by ballot, and is determined in favour of a candidate, if he ſhall have the votes of two-thirds of thoſe preſent, in a meeting conſiſting of at leaſt 21 members. The general buſineſs of the ſociety is managed by a preſident, two vice-preſidents, with a council of 12, a general ſecretary, and a treaſurer. Theſe officers are choſen by ballot annually on the laſt Monday of November. All public deeds, whether of a civil or of a literary nature, are tranſacted by this board, and proceed in the name of the preſident or vice-preſident.

As it was thought that the members would have a greater inducement to punctual attendance on the meetings of the ſociety, if they had ſome general intimation of the nature of the ſubjects which were to be conſidered, and made the topics of converſation, it was there-

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fore reſolved to divide the ſociety into two claſſes, which ſhould meet and deliberate ſeparately. One of theſe claſſes is denominated the *Phyſical Claſs*, and has for its department the ſciences of mathematics, natural philoſophy, chemiſtry, medicine, natural hiſtory, and whatever relates to the improvement of arts and manufactures. The other is denominated the *Literary Claſs*, and has for its department literature, philology, hiſtory, antiquities, and ſpeculative philoſophy. Every member is deſired at his admiſſion to intimate which of thoſe claſſes he wiſhes to be more particularly aſſociated with; but he is at the ſame time intitled to attend the meetings of the other claſs, and to take part in all its proceedings. Each of the claſſes has four preſidents and two ſecretaries, who officiate by turns. The meetings of the phyſical claſs are held on the firſt Mondays of January, February, March, April, July, Auguſt, November, and December; and the meetings of the Literary claſs are held on the third Mondays of January, February, March, April, June, July, November, and December, at 7 o'clock afternoon.

At theſe meetings the written eſſays and obſervations of the members of the ſociety, or their correſpondents, are read publicly, and become the ſubjects of converſation. The ſubjects of theſe eſſays and obſervations are announced at a previous meeting, in order to engage the attendance of thoſe members who may be particularly intereſted in them. The author of each diſſertation is likewiſe deſired to furniſh the ſociety with an abſtract of it, to be read at the next enſuing meeting, when the converſation is renewed with increaſed advantage, from the knowledge previouſly acquired of the ſubject. At the ſame meetings are exhibited ſuch ſpecimens of natural or artificial curioſities, ſuch remains of antiquity, and ſuch experiments, as are thought worthy of the attention of the ſociety. All objects of natural hiſtory preſented to the ſociety, are ordered by the charter of the inſtitution to be depoſited, on receipt, in the muſeum of the univerſity of Edinburgh; and all remains of antiquity, public records, or ancient manuſcripts, in the library belonging to the faculty of advocates at Edinburgh.

The ordinary members, whoſe uſual reſidence is in the city of Edinburgh or its immediate neighbourhood, are expected to attend regularly the monthly meetings; and are required to defray, by an annual contribution, the current expences of the inſtitution. The members who reſide at ſuch a diſtance from Edinburgh, that they cannot enjoy the advantages ariſing from a regular attendance on the meetings of the ſociety, are not ſubjected to any contribution for defraying its expences, but have a right to attend thoſe meetings when occaſionally in Edinburgh, and to take part in all their proceedings.

Three volumes of the Tranſactions of the ſociety have been publiſhed, which bear ample teſtimony to the learning and acuteneſs of their various authors.

3. *Medical Society* of London, inſtituted in the year 1752, on the plan recommended by Lord Bacon (*De Augm. Scient.* lib. iv. cap. 2.), to revive the Hippocratic method of compoſing narratives of particular caſes, in which the nature of the diſeaſe, the manner of treating it, and the conſequences, are to be ſpecified; to attempt the cure of thoſe diſeaſes which, in his opinion, have been too boldly pronounced incurable; and, laſtly, to extend their inquiries after the powers of particular medicines in the cure of particular caſes; the collections of this ſociety have been already publiſhed, under the title of *Medical Obſervations and Inquiries*, in ſeveral volumes.

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4. *The Medical Society* of Edinburgh was incorporated by royal charter in 1778; but there appears to have been in that city a voluntary aſſociation of the ſame name from the firſt eſtabliſhment of a regular ſchool of phyſic in the univerſity. To the voluntary ſociety the public is indebted for ſix volumes of curious and uſeful eſſays, collected principally by the late Dr Monro from June 1731 to June 1736; but in the year 1739 that ſociety was united to another, as we have already obſerved in a former article. The ordinary members of the preſent medical ſociety are elected by ballot, and three diſſentient exclude a candidate; an ordinary member may alſo be elected an honorary member, who enjoys the privileges of the others, and receives a diploma, but is freed from the obligation of attendance, delivering papers in rotation, &c. to which the ordinary members are ſubject; but in this caſe the votes muſt be unanimous. The meetings of this ſociety are held every Saturday evening in their own hall, during the winter ſeaſon, when papers on medical ſubjects are delivered by the ſeveral members in rotation; and four of theſe are annually elected to fill the chair in rotation, with the title of annual preſidents.

5. The *Royal Medical Society* of Paris was inſtituted in 1776. The members are divided into aſſociates ordinary, limited to 30, honorary to 12, extraordinary to 60, and foreign to 60, and correſpondents. This ſociety has publiſhed ſeveral volumes of Memoirs in 4to.

6. *Aſiatic Society*, an inſtitution planned by the late illuſtrious Sir William Jones, and actually formed at Calcutta on the 15th of January 1784, for the purpoſe of tracing the hiſtory, antiquities, arts, ſciences, and literature, of the immenſe continent of Aſia. As it was reſolved to follow as nearly as poſſible the plan of the Royal Society of London, of which the king is *patron*, the patronage of the Aſiatic Society was offered to the governor-general and council, as the executive power in the territories of the company. By their acceptance of this offer, Mr Haſtings, as governor-general, appeared among the patrons of the new ſociety; "but he ſeemed in his private ſtation as the firſt liberal promoter of uſeful knowledge in Bengal, and eſpecially as the great encourager of Perſian and Shanſcrit literature, to deſerve a particular mark of diſtinction:" he was requeſted, therefore, to accept the honorary title of preſident. This was handſomely declined in a letter from Mr Haſtings, in which he requeſted "to yield his pretenſions to the gentleman whoſe genius planned the inſtitution, and was moſt capable of conducting it to the attainment of the great and ſplendid purpoſes of its formation." On the receipt of this letter, Sir William Jones was nominated preſident of the ſociety; and we cannot give the reader a view of the object of the inſtitution in clearer language than that which he employed in his firſt diſcourſe from the chair.

"It is your deſign, I conceive (ſaid the preſident), to take an ample ſpace for your learned inveſtigations, bounding them only by the geographical limits of Aſia; ſo that, conſidering Hindoſtan as a centre, and turning your eyes in idea to the north, you have on your right

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many important kingdoms in the eaſtern peninſula, the ancient and wonderful empire of China with all her Tartarian dependencies, and that of Japan, with the cluſter of precious iſlands, in which many ſingular curioſities have too long been concealed: before you lies that prodigious chain of mountains, which formerly perhaps were a barrier againſt the violence of the ſea, and beyond them the very intereſting country of Tibet, and the vaſt regions of Tartary, from which, as from the Trojan horſe of the poets, have iſſued ſo many conſummate warriors, whoſe domain has extended at leaſt from the banks of the Ilyſſus to the mouths of the Ganges: on your left are the beautiful and celebrated provinces of Iran or Perſia, the unmeaſured and perhaps unmeaſurable deſerts of Arabia, and the once flouriſhing kingdom of Yemen, with the pleaſant iſles that the Arabs have ſubdued or colonized; and farther weſtward, the Aſiatic dominions of the Turkiſh ſultans, whoſe moon ſeems approaching rapidly to its wane. By this great circumference the field of your uſeful reſearches will be incloſed; but ſince Egypt had unqueſtionably an old connection with this country, if not with China, ſince the language and literature of the Abyſſinians bear a manifeſt affinity to thoſe of Aſia, ſince the Arabian arms prevailed along the African coaſt of the Mediterranean, and even erected a powerful dynaſty on the continent of Europe, you may not be diſpleaſed occaſionally to follow the ſtreams of Aſiatic learning a little beyond its natural boundary; and, if it be neceſſary or convenient that a ſhort name or epithet be given to our ſociety, in order to diſtinguiſh it in the world, that of *Aſiatic* appears both claſſical and proper, whether we conſider the place or the object of the inſtitution, and preferable to *Oriental*, which is in truth a word merely relative, and though commonly uſed in Europe, conveys no very diſtinct idea.

"If now it be aſked, What are the intended objects of our inquiries within theſe ſpacious limits? we anſwer, MAN and NATURE; whatever is performed by the *one* or produced by the *other*. Human knowledge has been elegantly analyſed according to the three great faculties of the mind, *memory*, *reaſon*, and *imagination*, which we conſtantly find employed in arranging and retaining, comparing and diſtinguiſhing, combining and diverſifying, the ideas, which we receive through our ſenſes, or acquire by reflection: hence the three main branches of learning are, *hiſtory*, *ſcience*, and *art*; the firſt comprehends either an account of natural productions, or the genuine records of empires and ſtates; the ſecond embraces the whole circle of pure and mixed mathematics, together with ethics and law, as far as they depend on the reaſoning faculty; and the third includes all the beauties of imagery and the charms of invention, diſplayed in modulated language, or repreſented by colour, figure, or ſound.

"Agreeably to this analyſis, you will inveſtigate whatever is rare in the ſtupendous fabric of nature, will correct the geography of Aſia by new obſervations and diſcoveries; will trace the annals and even traditions of thoſe nations who from time to time have peopled or deſolated it; and will bring to light their various forms of government, with their inſtitutions civil and religious; you will examine their improvements and methods in arithmetic and geometry; in trigonometry, menſuration, mechanics, optics, aſtronomy, and general phyſics; their ſyſtems of morality, grammar, rhetoric, and dialectic; their ſkill in chirurgery and medicine; and their advancement, whatever it may be, in anatomy and chemiſtry. To this you will add reſearches into their agriculture, manufactures, trade; and whilſt you inquire with pleaſure into their muſic, architecture, painting, and poetry, will not neglect thoſe inferior arts by which the comforts and even elegancies of ſocial life are ſupplied or improved. You may obſerve, that I have omitted their languages, the diverſity and difficulty of which are a ſad obſtacle to the progreſs of uſeful knowledge; but I have ever conſidered languages as the mere inſtruments of real learning, and think them improperly confounded with learning itſelf: the attainment of them is, however, indiſpenſably neceſſary; and if to the Perſian, Armenian, Turkiſh, and Arabic, could be added not only the Shanſcrit, the treaſures of which we may now hope to ſee unlocked, but even the Chineſe, Tartarian, Japaneſe, and the various inſular dialects, an immenſe mine would then be open, in which we might labour with equal delight and advantage."

Of this ſociety three volumes of the Tranſactions have been publiſhed, which are replete with information in a high degree curious and important; and we hope that the European world ſhall ſoon be favoured with another. The much-to-be lamented death of the accompliſhed preſident may indeed damp the ſpirit of inveſtigation among the members; for to conquer difficulties ſo great as they muſt meet with, a portion ſeems to be neceſſary of that enthuſiaſm which accompanied all the purſuits of Sir William Jones; but his ſucceſſor is a man of great worth and learning, and we truſt will uſe his utmoſt endeavours to have the plan completed of which Sir William gave the outlines.

5. *The American Philoſophical Society*, held at Philadelphia, was formed in January 1769 by the union of two ſocieties which had formerly ſubſiſted in that city. This ſociety extends its attention to geography, mathematics, natural philoſophy, and aſtronomy; medicine and anatomy; natural hiſtory and chemiſtry; trade and commerce; mechanics and architecture; huſbandry and American improvements. Its officers are a patron, preſident, three vice-preſidents, one treaſurer, four ſecretaries, and three curators, who are annually choſen by ballot. The duty of the preſident, vice-preſidents, treaſurer, and ſecretaries, is the ſame as in other ſocieties. The buſineſs of the curators is to take the charge of all ſpecimens of natural productions, whether of the animal, vegetable, or foſſil kingdom; all models of machines and inſtruments; and all other matters belonging to the ſociety which ſhall be intruſted to them. The ordinary meetings are held on the firſt and third Fridays of every month from October to May incluſive. This ſociety was incorporated by charter 15th March 1780; and has publiſhed three volumes of its Tranſactions, containing many ingenious papers on general literature and the ſciences, as well as reſpecting thoſe ſubjects peculiar to America. It is a delightful proſpect to the philoſopher to conſider, that Aſia, Europe, and America, though far ſeparated and divided into a variety of political ſtates, are all three combined to promote the cauſe of knowledge and truth.

6. *A Literary and Philoſophical Society* of conſiderable reputation has been lately eſtabliſhed at Manchester, under the direction of two preſidents, four vice-preſi-

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dents, and two ſecretaries. The number of members is limited to 50; beſides whom there are ſeveral honorary members, all of whom are elected by ballot; and the officers are choſen annually in April. Four volumes of valuable eſſays have been already publiſhed by this ſociety.

7. *Society for Promoting the Diſcovery of the Interior Parts of Africa.* This ſociety or aſſociation for exploring the internal diſtricts of Africa, of which ſo little is at preſent known, was formed in London by ſome opulent individuals in 1788; who, ſtrongly impreſſed with a conviction of the practicability and utility of thus enlarging the fund of human knowledge, determined if poſſible to reſcue the age from that ſtigma which attaches to its ignorance of ſo large and ſo near a portion of the globe. The founders of this ſociety reſolved to admit no man a member for a ſhorter period than three years, during which he muſt pay annually into the public fund five guineas. After three years, any member, upon giving a year's notice, may withdraw himſelf from the aſſociation. During the firſt 12 months each of the members was allowed to recommend for the approbation of the ſociety ſuch of his friends as he might think proper to be admitted into it; but ſince that period we believe all additional members have been elected by a ballot of the aſſociation at large. A committee was choſen by ballot to manage the funds of the ſociety, to chooſe proper perſons to be ſent on the diſcovery of the interior parts of Africa, and to carry on the ſociety's correſpondence, with expreſs injunctions to diſcloſe no intelligence received from their agents but to the ſociety at large. But a fuller account of the nature of this eſtabliſhment, and the very happy efforts they have made, may be ſeen in the ſuperb edition of their proceedings printed in 1790, 4to, for their own uſe; or in the 8vo edition ſince made public. They ſoon found two gentleman, Mr Lucas and Mr Ledyard, who were ſingularly well qualified for the important miſſion. The information they have acquired will be found in the above work; with a new map by Mr Rennel, exhibiting the geographical knowledge collected by the African aſſociation. Mr Ledyard very unfortunately died during his reſearches at Cairo.

8. *The Society of Antiquaries of London*, was founded about the year 1572 by Archbiſhop Parker, a munificent patron of learned men. For the ſpace of 20 years it aſſembled in the houſe of Sir Robert Cotton; in 1589 they reſolved to apply to Queen Elizabeth for a charter and a public building where they might hold their meetings; but it is uncertain whether any ſuch application was ever made. In the mean time, the reputation of the ſociety gradually increaſed, and at length it excited the jealouſy of James I. who was afraid leſt it ſhould preſume to canvaſs the ſecret tranſactions of his government. He accordingly diſſolved it. But in the beginning of the preſent century, the Antiquarian Society began to revive; and a number of gentlemen, eminent for their affection to this ſcience, had weekly meetings, in which they examined the antiquities and hiſtory of Great Britain preceding the reign of James I. but without excluding any other remarkable antiquities that might be offered to them. From this time the ſociety grew in importance; and in 1750 they unanimouſly reſolved to petition the king for a charter of incorporation. This they obtained the year following, by the influence of the celebrated earl of Hardwicke, then lord-chancellor, and Martin Folkes, Eſq; who was then their preſident. The king declared himſelf their founder and patron, and empowered them to have a body of ſtatutes, and a common ſeal, and to hold in perpetuity lands, &c. to the yearly value of L. 1000.

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The chief object of the inquiries and reſearches of the ſociety are Britiſh antiquities and hiſtory; not, however, wholly excluding thoſe of other countries. It muſt be acknowledged, that the ſtudy of antiquity offers to the curious and inquiſitive a large field for reſearch and amuſement. The inquirer in this branch furniſhes the hiſtorian with his beſt materials, while he diſtinguiſhes from truth the fictions of a bold invention, and aſcertains the credibility of facts; and to the philoſopher he preſents a fruitful ſource of ingenious ſpeculation, while he points out to him the way of thinking, and the manners of men, under all the varieties of aſpect in which they have appeared.

An antiquarian ought to be a man of ſolid judgment, poſſeſſed of learning and ſcience, that he may not be an enthuſiaſtic admirer of every thing that is ancient merely becauſe it is ancient; but be qualified to diſtinguiſh between thoſe reſearches which are valuable and important, and thoſe which are trifling and uſeleſs. It is from the want of theſe qualifications that ſome men have contracted ſuch a blind paſſion for every thing that is ancient, that they have expoſed themſelves to ridicule, and their ſtudy to contempt. But if a regard to utility were always to regulate the purſuits of the antiquarian, the ſhafts of ſatire would no longer be levelled at him; but he would be reſpected as the man who labours to reſtore or to preſerve ſuch ancient productions as are ſuited to illuminate religion, philoſophy, and hiſtory, or to improve the arts of life.

We by no means intend to apply theſe obſervations to any particular ſociety of antiquarians; but we throw them out, becauſe we know that an aſſiduous ſtudy of antiquity is apt, like the ardent purſuit of money, to loſe ſight of its original object, and to degenerate into a paſſion which miſtakes the mean for the end, and conſiders poſſeſſion without a regard to utility as enjoyment.

An aſſociation ſimilar to that of the Antiquarian Society of London was founded in *Edinburgh* in 1780, and received the royal charter in 1783.

Beſides theſe literary ſocieties here mentioned, there are a great number more in different parts of Europe, ſome of which are noticed under the article ACADEMY. Thoſe which are omitted are not omitted on account of any idea of their inferior importance; but either becauſe we have had no acceſs to authentic information, or becauſe they reſemble the ſocieties already deſcribed ſo cloſely, that we could have given nothing but their names.

III. SOCIETIES FOR ENCOURAGING AND PROMOTING ARTS, MANUFACTURES, &c.

1. *London Society for the Encouragement of Arts, Manufactures, and Commerce*, was inſtituted in the year 1754 by Lord Folkſtone, Lord Romney, Dr Stephen Hales, and a few private gentlemen; but the merit of this inſtitution chiefly belonged to Mr William Shipley,

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an ingenious mechanic; who, though deriving no advantages from learning, by unwearied perſonal attendance found means to engage a few perſons of rank and fortune to meet at Peele's coffeehouſe in Fleetſtreet, and to adopt a plan for promoting arts and manufactures.

The office-bearers of this ſociety are a preſident, 12 vice preſidents, a ſecretary, and regiſter. Their proceedings are regulated by a body of rules and orders eſtabliſhed by the whole ſociety, and printed for the uſe of the members. All queſtions and debates are determined by the holding up of hands, or by ballot if required; and no matter can be confirmed without the aſſent of a majority at two meetings. They invite all the world to propoſe ſubjects for encouragement; and whatever is deemed deſerving attention is referred to the conſideration of a committee, which, after due inquiry and deliberation, make their report to the whole ſociety, where it is approved, rejected, or altered. A liſt is printed and publiſhed every year of the matters for which they propoſe to give premiums; which premiums are either ſums of money, and thoſe ſometimes very conſiderable ones; or the ſociety's medal in gold or ſilver, which they conſider as the greateſt honour they can beſtow. All poſſible care is taken to prevent partiality in the diſtribution of their premiums, by deſiring the claimants names to be concealed, and by appointing committees (who when they find occaſion call to their aſſiſtance the moſt ſkilful artiſts) for the ſtrict examination of the real merit of all matters and things brought before them, in conſequence of their premiums.

The chief objects of the attention of the Society for the Encouragement of Arts, Manufactures, and Commerce, in the application of their rewards, are ingenuity in the ſeveral branches of the polite and liberal arts, uſeful diſcoveries and improvements in agriculture, manufactures, mechanics, and chemiſtry, or the laying open of any ſuch to the public; and, in general, all ſuch uſeful inventions, diſcoveries, or improvements (though not mentioned in the book of premiums), as may appear to have a tendency to the advantage of trade and commerce.

The following are ſome of the moſt important regulations of this ſociety. It is required that the matters for which premiums are offered be delivered in without names, or any intimation to whom they belong; that each particular thing be marked in what manner each claimant thinks fit, ſuch claimant ſending with it a paper ſealed up, having on the outſide a correſponding mark, and on the inſide the claimant's name and addreſs; and all candidates are to take notice, that no claim for a premium will be attended to, unleſs the conditions of the advertiſement are fully complied with. No papers ſhall be opened but ſuch as ſhall gain premiums, unleſs where it appears to the ſociety abſolutely neceſſary for the determination of the claim: all the reſt ſhall be returned unopened, with the matters to which they belong, if inquired after by the marks within two years; after which time, if not demanded, they ſhall be publicly burnt unopened at ſome meeting of the ſociety. All the premiums of this ſociety are deſigned for that part of Great Britain called England, the dominion of Wales, and the town of Berwick upon Tweed, unleſs expreſsly mentioned to the contrary. No perſon ſhall receive any premium, bounty, or encouragement, from the ſociety for any matter for which he has obtained or propoſes to obtain a patent. No member of this ſociety ſhall be a candidate for or intitled to receive any premium, bounty, or reward whatſoever, except the honorary medal of the ſociety.

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The reſpectability of the members who compoſe it may be ſeen by peruſing the liſt which generally accompanies their Tranſactions. In the laſt volume (vol. xii.) it occupies no leſs than 43 pages. Some idea may be formed of the wealth of this ſociety, by obſerving that the liſt of their premiums fills 96 pages, and amounts to 250 in number. Theſe conſiſt of gold medals worth from 30 to 50, and in a few inſtances to 100, guineas; and ſilver medals valued at 10 guineas.

This ſociety is one of the moſt important in Great Britain. Much money has been expended by it, and many are the valuable effects of which it has been productive. Among theſe we reckon not only the diſcoveries which it has excited, but the inſtitution of other ſocieties on the ſame principles to which it has given birth; and we do not heſitate to conclude, that future ages will conſider the founding of this ſociety as one of the moſt remarkable epochs in the hiſtory of the arts. We contemplate with pleaſure the beneficial effects which muſt reſult to this nation and to mankind by the diffuſion of ſuch inſtitutions; and rejoice in the hope that the active minds of the people of Great Britain, inſtead of being employed as formerly in controverſies about religion, which engender ſtrife, or in diſcuſſions concerning the theory of politics, which lead to the adoption of ſchemes inconſiſtent with the nature and condition of man, will ſoon be more generally united into aſſociations for promoting uſeful knowledge and ſolid improvement, and for alleviating the diſtreſſes of their fellow-creatures.

2 *Society inſtituted at Bath for the Encouragement of Agriculture, Arts, Manufactures, and Commerce.* It was founded in the year 1777 by ſeveral gentlemen who met at the city of Bath. This ſcheme met with a very favourable reception both from the wealthy and learned. The wealthy ſubſcribed very liberally, and the learned communicated many important papers. On application to the London and provincial ſocieties inſtituted for the like purpoſes, they very politely offered their aſſiſtance. Seven volumes of their tranſactions have already been publiſhed, containing very valuable experiments and obſervations, particularly reſpecting agriculture, which well deſerve the attention of all farmers in the kingdom. We have conſulted them with much ſatisfaction on ſeveral occaſions, and have frequently referred to them in the courſe of this work; and therefore, with pleaſure, embrace the preſent opportunity of repeating our obligations. We owe the ſame acknowledgments to the Society for the Improvement of Arts, &c. of London.

3. *Society for Working Mines*, an aſſociation lately formed on the continent of Europe. This inſtitution aroſe from the accidental meeting of ſeveral mineralogiſts at Skleno near Schemnitz in Hungary, who were collected in order to examine a new method of amalgamation. Struck with the ſhackles impoſed on mineralogy by monopolizers of new and uſeful proceſſes, they thought no method ſo effectual to break them, as forming a ſociety, whoſe common labours ſhould be directed to fix mining on its ſureſt principles; and whoſe memoirs,

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ſpread over all Europe, might offer to every adventurer the reſult of the reſearches, of which they are the object. By theſe means they ſuppoſed, that there would be a maſs of information collected; the intereſts of individuals would be loſt in the general intereſt; and the one would materially aſſiſt the other. Impoſture and quackery would, by the ſame means, be baniſhed from a ſcience, which muſt be improved by philoſophy and experience; and the ſociety, they ſuppoſed, would find, in the confidence which they inſpired, the reward and the encouragement of their labours. They deſign, that the memoirs which they publiſh ſhall be ſhort and clear; truth muſt be their baſis, and every idle diſcuſſion, every foreign digreſſion, muſt be baniſhed; politics and finance muſt be avoided, though the diſſertations may ſeem to lead towards them; and they oblige themſelves to oppoſe the affectation of brilliancies, and the oſtentation of empty ſpeculation, when compared with plain, ſimple, and uſeful facts.

The object of the ſociety is phyſical geography; mineralogy founded on chemiſtry; the management of ore in the different operations which it undergoes; ſubterraneous geometry; the hiſtory of mining; founderies, and the proceſſes for the extraction of metals from the ores, either by fuſion or amalgamation, in every inſtance applied to practice. The end of this inſtitution is to collect, in the moſt extenſive ſenſe, every thing that can aſſiſt the operations of the miner, and to communicate it to the different members, that they may employ it for the public good, in their reſpective countries. Each member muſt conſider himſelf as bound to ſend to the ſociety every thing which will contribute to the end of its inſtitution; to point out, with preciſion, the ſeveral facts and obſervations; to communicate every experiment which occurs, even the unſucceſsful ones, if the relation may ſeem to be advantageous to the public; to communicate to the ſociety their examination of ſchemes, and their opinions on queſtions propoſed by it; and to pay annually two ducats (about 18 s. 6 d.) to the direction every Eaſter. The ſociety, on the other hand, is bound to publiſh every novelty that ſhall be communicated to it; to communicate to each member, at the member's expence, the memoirs, deſigns, models, productions, and every thing connected with the inſtitution; to anſwer all the neceſſary demands made, relating in any reſpect to mining; and to give its opinion on every plan or project communicated through the medium of an honorary member.

The great centre of all intelligence is to be at Zellerfield in Hartz, Brunſwick: but the ſociety is not fixed to any one ſpot; for every particular ſtate ſome practical mineralogiſt is nominated as director. Among theſe are the names of Baron Born, M. Pallas, M. Charpentier, M. Prebra, and M. Henkel. Their office is to propoſe the members; to take care that the views of the ſociety are purſued in the different countries where they reſide; to anſwer the requeſts of the members of their country who are qualified to make them; in caſe of the death of a director, to chooſe another; and the majority is to determine where the archives and the ſtrong box is to be placed.

All the eminent mineralogiſts in Europe are members of this ſociety. It is erected on ſo liberal and ſo extenſive a plan, that we entertain the higheſt hopes of its ſucceſs; and have only to add, that we wiſh much to ſee the ſtudy of ſeveral other ſciences purſued in the ſame manner.

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4. *The Society for the Improvement of Naval Architecture*, was founded in 1791. The object of it is to encourage every uſeful invention and diſcovery relating to naval architecture as far as ſhall be in their power, both by honorary and pecuniary rewards. They have in view particularly to improve the theories of floating bodies and of the reſiſtance of fluids; to procure draughts and models of different veſſels, together with calculations of their capacity, centre of gravity, tonnage, &c.; to make obſervations and experiments themſelves, and to point out ſuch obſervations and experiments as appear beſt calculated to further their deſigns, and moſt deſerving thoſe premiums which the ſociety can beſtow. But though the improvement of naval architecture in all its branches be certainly the principal object of this inſtitution, yet the ſociety do not by any means intend to confine themſelves merely to the form and ſtructure of veſſels. Every ſubordinate and collateral purſuit will claim a ſhare of the attention of the ſociety in proportion to its merits; and whatever may have any tendency to render navigation more ſafe, ſalutary, and even pleaſant, will not be neglected.

This inſtitution owes its exiſtence to the patriotic diſpoſition and extraordinary attention of Mr Sewel a private citizen of London, who (though engaged in a line of buſineſs totally oppoſite to all concerns of this kind) has been led, by mere accident, to take ſuch occular notice of, and make ſuch obſervations on, the actual ſtate of naval architecture in this country, as naturally occurred to a man of plain underſtanding, zealous for the honour and intereſt of his country, and willing to beſtow a portion of that time for the public good, which men of a different deſcription would rather have devoted to their own private advantage. His attention was the more ſeriouſly excited, by finding that it was the opinion of ſome private ſhip-builders, who, in a debate on the failure of one of our naval engagements, pronounced, that ſuch "would ever be the caſe while that buſineſs (the conſtruction of our ſhips of war) was not ſtudied as a ſcience, but carried on merely by precedent; that there had not been one improvement in our navy that did not originate with the French, who had naval ſchools and ſeminaries for the ſtudy of it; and that our ſhips were not a match for thoſe of that nation either ſingly or in a fleet, &c. &c."

In a ſhort time the ſociety were enabled to offer very conſiderable premiums for particular improvements in the conſtruction of our ſhipping, &c. &c. and alſo to encourage our philoſophers, mathematicians, and mechanics, to make ſatisfactory experiments, tending to aſcertain the laws of reſiſtance of water to ſolids of different forms, in all varieties of circumſtance. On this head the reward is not leſs than L. 100 pounds or a gold medal. Other premiums of 50, 30, and 20 guineas, according to the importance or difficulty of the particular ſubject or point of inveſtigation, are likewiſe offered, for different diſcoveries, inventions, or improvements. The terms of admiſſion into the ſociety are a ſubſcription of two guineas annually, or twenty guineas for life.

5. *Society of Artiſts of Great Britain*, which conſiſts of directors and fellows, was incorporated by charter in 1765, and empowered to purchaſe and hold lands, not exceeding

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exceeding L. 1000 a year. The directors of this ſociety, annually elected, are to conſiſt of 24 perſons, including the preſident, vice-preſident, treaſurer, and ſecretary; and it is required that they be either painters, ſculptors, architects, or engravers by profeſſion.

6. *Britiſh Society for Extending the Fiſheries and Improving the Sea-Coaſts of this Kingdom*, was inſtituted in 1786. The end and deſign of this ſociety will beſt appear from their charter, of which we preſent an abſtract.

The preamble ſtates, "the great want of improvement in fiſheries, agriculture, and manufactures, in the Highlands and iſlands of North Britain; the prevalence of emigration from the want of employment in thoſe parts; the proſpect of a new nurſery of ſeamen, by the eſtabliſhment of fiſhing towns and villages in that quarter. The act therefore declares, that the perſons therein named, and every other perſon or perſons who ſhall thereafter become proprietors of the joint ſtock mentioned therein, ſhall be a diſtinct and ſeparate body politic and corporate, by the name of *The Britiſh Society for Extending the Fiſheries and Improving the Sea-coaſts of this Kingdom*: That the ſaid ſociety may raiſe a capital joint ſtock not exceeding L. 150,000, to be applied to purchaſing or otherwiſe acquiring lands and tenements in perpetuity, for the building thereon, and on no other land whatever, free towns, villages, and fiſhing ſtations: That the joint ſtock ſhall be divided into ſhares of L. 50 each: That no one perſon ſhall in his or her name poſſeſs more than ten ſhares, or L. 500: That the ſociety ſhall not borrow any ſum or ſums of money whatſoever: That the ſums to be advanced for this undertaking, and the profits ariſing therefrom, ſhall be divided proportionably to the ſum ſubſcribed; and that no perſon ſhall be liable for a larger ſum than he or ſhe ſhall have reſpectively ſubſcribed: That one or two ſhares ſhall intitle to one vote and no more, in perſon or by proxy, at all meetings of proprietors; three or four ſhares to two votes; five, ſix, or ſeven ſhares, to three votes; eight or nine ſhares to four votes; and ten ſhares to five votes and no more: That more perſons than one inclining to hold in their joint names one or more ſhares ſhall be intitled to vote, by one of ſuch perſons, according to the priority of their names, or by proxy: That bodies corporate ſhall vote by proxy under their ſeal: That all perſons holding proxies ſhall be proprietors, and that no one perſon ſhall hold more than five votes by proxy: That the affairs of the ſociety ſhall be managed by a governor, deputy governor, and 13 other directors, to be elected annually on the 25th of March, from among the proprietors of the ſociety, holding at leaſt one full ſhare, by ſigned liſts of their names to be tranſmitted by the proprietors to the ſecretary of the ſociety: that five proprietors, not being governor, director, or other officer, ſhall be in like manner annually elected to audit the accounts of the ſociety: That there ſhall be one general meeting of the proprietors annually on the 25th of March: That occaſional general meetings ſhall be called on the requeſt of nine or more proprietors: That the general meetings of the proprietors ſhall make all bye-laws and conſtitutions for the government of the ſociety, and for the good and orderly carrying on of the buſineſs of the ſame: That no transfer ſhall be made of the ſtock of the ſociety for three years from the 10th of Auguſt 1786: That the caſh of the ſociety ſhall be lodged in the bank of England, bank of Scotland, or the royal bank of Scotland: That no director, proprietor, agent, or officer of the ſociety, ſhall retain any ſum or ſums of money in his hands beyond the ſpace of 30 days, on any account whatſoever: That all payments by the ſociety ſhall be made by drafts on the ſaid banks, under the hands of the governor or deputy-governor, counterſigned by the ſecretary or his deputy, and two or more directors: And that the books in which the accounts of the ſociety ſhall be kept ſhall be open to all the proprietors."

Societies for Encouraging and Promoting Arts, Manufactures, &c. Socinians.

The inſtitution of this public-ſpirited ſociety was in a great meaſure owing to the exertions of the patriotic John Knox; who, in the courſe of 23 years, traverſed and explored the Highlands of Scotland no leſs than 16 times, and expended ſeveral thouſand pounds of his own fortune in purſuing his patriotic deſigns.

7. *Britiſh Wool Society*. See *Britiſh Wool Society*.

Society Iſles, a cluſter of iſles, ſo named by Captain Cook in 1769. They are ſituated between the latitudes of 16. 10. and 16. 55. ſouth, and between the longitudes of 150. 57. and 152. weſt. They are eight in number; namely, Otaheite, Huahine, Ulietea, Otaha, Bolabola, Maurua, Toobouai, and Tabooyamanoo or Saunders's Iſland. The ſoil, productions, people, their language, religion, cuſtoms, and manners, are ſo nearly the ſame as at Otaheite, that little need be added here on that ſubject. Nature has been equally bountiful in uncultivated plenty, and the inhabitants are as luxurious and as indolent. A plantain branch is the emblem of peace, and exchanging names the greateſt token of friendſhip. Their dances are more elegant, their dramatic entertainments have ſomething of plot and conſiſteney, and they exhibit temporary occurrences as the objects of praiſe or ſatire; ſo that the origin of ancient comedy may be already diſcerned among them. The people of Huahine are in general ſtouter and fairer than thoſe of Otaheite, and this iſland is remarkable for its populouſneſs and fertility. Thoſe of Ulietea, on the contrary, are ſmaller and blacker, and much leſs orderly. Captain Cook put on ſhore a Cape ewe at Bolabola, where a ram had been left by the Spaniards; and alſo an Engliſh boar and ſow, with two goats, at Ulietea. If the valuable animals which have been tranſported thither from Europe ſhould be ſuffered to multiply, no part of the world will equal theſe iſlands in variety and abundance of refreſhments for future navigators.

SOCINIANS, in church-hiſtory, a ſect of Chriſtian heretics, ſo called from their founder Fauſtus Socinus (ſee Socinus). They maintain, "That Jeſus Chriſt was a mere man, who had no exiſtence before he was conceived by the Virgin Mary; that the Holy Ghoſt is no diſtinct perſon, but that the Father is truly and properly God. They own, that the name of God is given in the Holy Scriptures to Jeſus Chriſt; but contend, that it is only a deputed title, which, however, inveſts him with an abſolute ſovereignty over all created beings, and renders him an object of worſhip to men and angels. They deny the doctrines of ſatisfaction and imputed righteouſneſs; and ſay that Chriſt only preached the truth to mankind, ſet before them in himſelf an example of heroic virtue, and ſealed his doctrines with his blood. Original ſin and abſolute predeſtination they eſteem ſcholaſtic chimeras. They likewiſe

Socinians, Socinus.

wise maintain the sleep of the soul, which they say becomes insensible at death, and is raised again with the body at the resurrection, when the good shall be established in the possession of eternal felicity, while the wicked shall be consigned to a fire that will not torment them eternally, but for a certain duration proportioned to their demerits."

This sect has long been indignant at being styled *Socinians*. They disclaim every human leader; and professing to be guided solely by the word of God and the deductions of reason, they call themselves *Unitarians*, and affect to consider all other Christians, even their friends the Arians, as *Polytheists*. Modern Unitarianism, as taught by Dr Priestley, is, however, a very different thing from Socinianism, as we find it in the Racovian catechism and other standard works of the sect. This far-famed philosopher has discovered what escaped the sagacity of all the *fratres poloni*, that Jesus Christ was the son of Joseph as well as Mary; that the evangelists mistook the meaning of Isaiah's prophecy, that "a virgin should conceive and bear a son;" that the applying of this prophecy to the birth of our Saviour, led them to conclude that his conception was miraculous; and that we are not to wonder at this mistake, as the apostles were not always inspired, and were in general inconclusive reasoners. The modesty of the writer in claiming the merit of such discoveries will appear in its proper colours to all our readers: the truth of his doctrine shall be considered in another place. See THEOLOGY.

SOCINUS (Lælius), the first author of the sect of the Socinians, was born at Sienna in Tuscany in 1525. Being designed by his father for the law, he began very early to search for the foundation of that science in the Word of God; and by that study discovered that the Romish religion taught many things contrary to revelation; when, being desirous of penetrating farther into the true sense of the Scriptures, he studied Greek, Hebrew, and even Arabic. In 1547 he left Italy, to go and converse with the Protestants; and spent four years in travelling thro' France, England, the Netherlands, Germany, and Poland, and at length settled at Zurich. He by this means became acquainted with the most learned men of his time, who testified by their letters the esteem they had for him: but as he discovered to them his doubts, he was greatly suspected of heresy. He, however, conducted himself with such address, that he lived among the capital enemies of his opinions, without receiving the least injury. He met with some disciples, who heard his instructions with respect; these were Italians who left their native country on account of religion, and wandered about in Germany and Poland. He communicated likewise his sentiments to his relations by his writings, which he caused to be conveyed to them at Sienna. He died at Zurich in 1562. Those who were of sentiments opposite to his, and were personally acquainted with him, confess that his outward behaviour was blameless. He wrote a Paraphrase on the first chapter of St John; and other works are ascribed to him.

SOCINUS (Faustus), nephew of the preceding, and principal founder of the Socinian sect, was born at Sienna in 1539. The letters which his uncle Lælius wrote to his relations, and which infused into them many seeds of heresy, made an impression upon him; so that, knowing himself not innocent, he fled as well as the rest when the inquisition began to persecute that family. He was at Lyons when he heard of his uncle's death, and departed immediately to take possession of his writings. He returned to Tuscany; and made himself so agreeable to the grand duke, that the charms which he found in that court, and the honourable posts he filled there, hindered him for twelve years from remembering that he had been considered as the person who was to put the last hand to the system of famosatenian divinity, of which his uncle Lælius had made a rough draught. At last he went into Germany in 1574, and paid no regard to the grand duke's advices to return. He staid three years at Basil, and studied divinity there; and having adopted a set of principles very different from the system of Protestants, he resolved to maintain and propagate them; for which purpose he wrote a treatise *De Iesu Christo Servatore*. In 1579 Socinus retired into Poland, and desired to be admitted into the communion of the Unitarians; but as he differed from them in some points, on which he refused to be silent, he met with a repulse. However, he did not cease to write in defence of their churches against those who attacked them. At length his book against James Paleologus furnished his enemies with a pretence to exasperate the king of Poland against him; but though the mere reading of it was sufficient to refute his accusers, Socinus thought proper to leave Cracow, after having resided there four years. He then lived under the protection of several Polish lords, and married a lady of a good family: but her death, which happened in 1587, so deeply afflicted him as to injure his health; and to complete his sorrow, he was deprived of his patrimony by the death of Francis de Medicis great duke of Florence. The consolation he found in seeing his sentiments at last approved by several ministers, was greatly interrupted in 1598; for he met with a thousand insults at Cracow, and was with great difficulty saved from the hands of the rabble. His house was plundered, and he lost his goods; but this loss was not so uneasy to him as that of some manuscripts, which he extremely regretted. To deliver himself from such dangers, he retired to a village about nine miles distant from Cracow, where he spent the remainder of his days at the house of Abraham Blonski, a Polish gentleman, and died there in 1604. All Faustus Socinus's works are contained in the two first volumes of the *Bibliotheca Fratrum Polonorum*.

Socinus || Socrates.

SOCMANS, SOKEMANS, or *Socmen* (*Socmanni*), are such tenants as hold their lands and tenements by socage tenure. See SOCAGE.

SOCOTORA, an island lying between Asia and Arabia Felix; about 50 miles in length, and 22 in breadth. It is particularly noted for its fine aloes, known by the name of *Socotrine* ALOES. The religion of the natives is a mixture of Mahometanism and Paganism; but they are civil to strangers who call there in their passage to the East Indies. It abounds in fruit and cattle; and they have a king of their own, who is dependent on Arabia.

SOCRATES, the greatest of the ancient philosophers, was born at Alopece, a village near Athens, in the fourth year of the 77th olympiad. His parents were of low rank; his father Sophroniscus being a statuary, and his mother Phænareta a midwife. Sophroniscus

Socrates. niſcus brought up his ſon, contrary to his inclination, in his own manual employment; in which Socrates, though his mind was continually aſpiring after higher objects, was not unſucceſsful; for whilſt he was a young man, he is ſaid to have formed ſtatues of the habited graces, which were allowed a place in the citadel of Athens. Upon the death of his father he was left in ſuch ſtraitened circumſtances as laid him under the neceſſity of exerciſing that art to procure the means of ſubſiſtence, though he devoted, at the ſame time, all the leiſure which he could command to the ſtudy of philoſophy. His diſtreſs, however, was ſoon relieved by Crito, a wealthy Athenian; who, remarking his ſtrong propenſity to ſtudy, and admiring his ingenuous diſpoſition and diſtinguiſhed abilities, generouſly took him under his patronage, and intruſted him with the inſtruction of his children. The opportunities which Socrates by this means enjoyed of attending the public lectures of the moſt eminent philoſophers, ſo far increaſed his thirſt after wiſdom, that he determined to relinquiſh his occupation, and every proſpect of emolument which that might afford, in order to devote himſelf entirely to his favourite purſuits. Under Anaxagoras and Archelaus he proſecuted the ſtudy of nature in the uſual manner of the philoſophers of the age, and became well acquainted with their doctrines. Prodicus the ſophiſt was his preceptor in eloquence, Evenus in poetry, Theodorus in geometry, and Damo in muſic. Aſpaſia, a woman no leſs celebrated for her intellectual than her perſonal accompliſhments, whoſe houſe was frequented by the moſt celebrated characters, had alſo ſome ſhare in the education of Socrates. Under ſuch preceptors it cannot reaſonably be doubted but that he became maſter of every kind of learning which the age in which he lived could afford; and being bleſſed with very uncommon talents by nature, he appeared in Athens, under the reſpectable characters of a good citizen and a true philoſopher Being called upon by his country to take arms in the long and ſevere ſtruggle between Athens and Sparta, he ſignalized himſelf at the ſiege of Potidæa, both by his valour and by the hardineſs with which he endured fatigue. During the ſeverity of a Thracian winter, whilſt others were clad in furs, he wore only his uſual clothing, and walked barefoot upon the ice. In an engagement in which he ſaw Alcibiades falling down wounded, he advanced to defend him, and ſaved both him and his arms: and though the prize of valour was on this occoſion unqueſtionably due to Socrates, he generouſly gave his vote that it might be beſtowed upon Alcibiades, to encourage his riſing merit. He ſerved in other campaigns with diſtinguiſhed bravery, and had the happineſs on one occaſion to ſave the life of Xenophon, by bearing him, when covered with wounds, out of the reach of the enemy.

It was not till Socrates was upwards of 60 years of age that he undertook to ſerve his country in any civil office, when he was choſen to repreſent his own diſtrict, in the ſenate of five hundred. In this office, though he at firſt expoſed himſelf to ſome degree of ridicule from the want of experience in the forms of buſineſs, he ſoon convinced his colleagues that he was ſuperior to them all in wiſdom and integrity. Whilſt they, intimidated by the clamours of the populace, paſſed an unjuſt ſentence of condemnation upon the commanders, who, after the engagement at the Arginuſian iſlands, had been prevented by a ſtorm from paying funeral honours to the dead, Socrates ſtood forth ſingly in their defence, and to the laſt refuſed to give his ſuffrage againſt them, declaring that no force ſhould compel him to act contrary to juſtice and the laws. Under the ſubſequent tyranny he never ceaſed to condemn the oppreſſive and cruel proceedings of the thirty tyrants; and when his boldneſs provoked their reſentment, ſo that his life was in hazard, fearing neither treachery nor violence, he ſtill continued to ſupport with undaunted firmneſs the rights of his fellow-citizens. Socrates.

Having given theſe proofs of public virtue both in a military and civil capacity, he wiſhed to do ſtill more for his country. Obſerving with regret how much the opinions of the Athenian youth were miſled, and their principles and taſte corrupted by philoſophers who ſpent all their time in refined ſpeculations upon nature and the origin of things, and by ſophiſts who taught in their ſchools the arts of falſe eloquence and deceitful reaſoning; Socrates formed the wiſe and generous deſign of inſtituting a new and more uſeful method of inſtruction. He juſtly conceived the true end of philoſophy to be, not to make an oſtentatious diſplay of ſuperior learning and ability in ſubtle diſputations or ingenious conjectures, but to free mankind from the dominion of pernicious prejudices; to correct their vices; to inſpire them with the love of virtue; and thus conduct them in the path of wiſdom to true felicity. He therefore aſſumed the character of a moral philoſopher; and, looking upon the whole city of Athens as his ſchool, and all who were diſpoſed to lend him their attention as his pupils, he ſeized every occaſion of communicating moral wiſdom to his fellow citizens. He paſſed the greater part of his time in public; and the method of inſtruction of which he chiefly made uſe was, to propoſe a ſerious of queſtions to the perſon with whom he converſed, in order to lead him to ſome unforeſeen concluſion. He firſt gained the conſent of his reſpondent to ſome obvious truths, and then obliged him to admit others from their relation or reſemblance to thoſe to which he had already aſſented. Without making uſe of any direct argument or perſuaſion, he choſe to lead the perſon he meant to inſtruct, to deduce the truths of which he wiſhed to convince him, as a neceſſary conſequence from his own conceſſions. He commonly conducted theſe conferences with ſuch addreſs, as to conceal his deſign till the reſpondent had advanced too far to recede. On ſome occaſions he made uſe of ironical language, that vain men might be caught in their own replies, and be obliged to confeſs their ignorance. He never aſſumed the air of a moroſe and rigid preceptor, but communicated uſeful inſtruction with all the eaſe and pleaſantry of polite converſation. Though eminently furniſhed with every kind of learning, he preferred moral to ſpeculative wiſdom. Convinced that philoſophy is valuable, not as it furniſhes queſtions for the ſchools, but as it provides men with a law of life, he cenſured his predeceſſors for ſpending all their time in abſtruſe reſearches into nature, and taking no pains to render themſelves uſeful to mankind. His favourite maxim was, Whatever is above us doth not concern us. He eſtimated the value of knowledge by its utility, and recommended the ſtudy of geometry, aſtronomy, and other ſciences, only ſo far as they admit of a practical application to the purpoſes of human life. His great

object

Socrates. object in all his conferences and diſcourſes was, to lead men into an acquaintance with themſelves; to convince them of their follies and vices; to inſpire them with the love of virtue; and to furniſh them with uſeful moral inſtructions. Cicero might therefore very juſtly ſay of Socrates, that he was the firſt who called down philoſophy from heaven to earth, and introduced her into the public walks and domeſtic retirements of men, that ſhe might inſtruct them concerning life and manners.

Through his whole life this good man diſcovered a mind ſuperior to the attractions of wealth and power. Contrary to the general practice of the preceptors of his time, he inſtructed his pupils without receiving from them any gratuity. He frequently refuſed rich preſents, which were offered him by Alcibiades and others, though importunately urged to accept them by his wife. The chief men of Athens were his ſtewards: they ſent him in proviſions, as they apprehended he wanted them; he took what his preſent wants required, and returned the reſt. Obſerving the numerous articles of luxury which were expoſed to ſale in Athens, he exclaimed, "How many things are there which I do not want!" With Socrates, moderation ſupplied the place of wealth. In his clothing and food, he conſulted only the demands of nature. He commonly appeared in a neat but plain clock, with his feet uncovered. Though his table was only ſupplied with ſimple fare, he did not ſcruple to invite men of ſuperior rank to partake of his meals; and when his wife, upon ſome ſuch occaſion, expreſſed her diſſatisfaction on being no better provided, he deſired her to give herſelf no concern; for if his gueſts were wiſe men, they would be contented with whatever they found at his table; if otherwiſe, they were unworthy of notice. Whilſt others, ſays he, live to eat, wiſe men eat to live.

Though Socrates was exceedingly unfortunate in his domeſtic connection, he converted this infelicity into an occaſion of exerciſing his virtues. Xantippe, concerning whoſe ill humour ancient writers relate many amuſing tales, was certainly a woman of a high and unmanageable ſpirit. But Socrates, while he endeavoured to curb the violence of her temper, improved his own. When Alcibiades expreſſed his ſurpriſe that his friend could bear to live in the ſame houſe with ſo perverſe and quarrelſome a companion, Socrates replied, that being daily inured to ill humour at home, he was the better prepared to encounter perverſeneſs and injury abroad.

In the midſt of domeſtic vexations and public diſorders, Socrates retained ſuch an unruffled ſerenity, that he was never ſeen either to leave his own houſe or to return home with a diſturbed countenance. In acquiring this entire dominion over his paſſions and appetites, he had the greater merit, as it was not effected without a violent ſtruggle againſt his natural propenſities. Zopyrus, an eminent phyſiognomiſt, declared, that he diſcovered in the features of the philoſopher evident traces of many vicious inclinations. The friends of Socrates who were preſent ridiculed the ignorance of this pretender to extraordinary ſagacity. But Socrates himſelf ingenuouſly acknowledged his penetration, and confeſſed that he was in his natural diſpoſition prone to vice, but that he had ſubdued his inclinations by the power of reaſon and philoſophy.

Through the whole of his life Socrates gave himſelf up to the guidance of unbiaſſed reaſon, which is ſuppoſed by ſome to be all that he meant by the genius or *dæmon* from which he profeſſed to receive inſtruction. But this opinion is inconſiſtent with the accounts given by his followers of that dæmon, and even with the language in which he ſpoke of it himſelf. Plato ſometimes calls it his *guardian*, and Apuleius his *god*; and as Xenophon atteſts that it was the belief of his maſter that the gods occaſionally communicate to men the knowledge of future events, it is by no means improbable that Socrates admitted, with the generality of his countrymen, the exiſtence of thoſe intermediate beings called *dæmons*, of one of which he might fancy himſelf the peculiar care. Socrates.

It was one of the maxims of Socrates, "That a wiſe man will worſhip the gods according to the inſtitutions of the ſtate to which he belongs." Convinced of the weakneſs of the human underſtanding, and perceiving that the pride of philoſophy had led his predeceſſors into futile ſpeculations on the nature and origin of things, he judged it moſt conſiſtent with true wiſdom to ſpeak with caution and reverence concerning the divine nature.

The wiſdom and the virtues of this great man, whilſt they procured him many followers, created him alſo many enemies. The Sophiſts§, whoſe knavery and ignorance he took every opportunity of expoſing to public contempt, became inveterate in their enmity againſt ſo bold a reformer, and deviſed an expedient, by which they hoped to check the current of his popularity. They engaged Ariſtophanes, the firſt buffoon of the age, to write a comedy, in which Socrates ſhould be the principal character. Ariſtophanes, pleaſed with ſo promiſing an occaſion of diſplaying his low and malignant wit, undertook the taſk, and produced the comedy of *The Clouds*, ſtill extant in his works. In this piece, Socrates is introduced hanging in a baſket in the air, and thence pouring forth abſurdity and prophaneneſs. But the philoſopher, ſhowing in a crouded theatre that he was wholly unmoved by this ribaldry, the ſatire failed of its effect; and when Ariſtophanes attempted the year following to renew the piece with alterations and additions, the repreſentation was ſo much diſcouraged, that he was obliged to diſcontinue it. § See *Sophiſt.*

From this time Socrates continued for many years to purſue without interruption his laudable deſign of inſtructing and reforming his fellow-citizens. At length, however, when the inflexible integrity with which he had diſcharged the duty of a ſenator, and the firmneſs with which he had oppoſed every kind of political corruption and oppreſſion, had greatly increaſed the number of his enemies, clandeſtine arts were employed to raiſe a general prejudice againſt him. The people were induſtriouſly reminded, that Critias, who had been one of the moſt cruel of the thirty tyrants, and Alcibiades, who had inſulted religion, by defacing the public ſtatues of Mercury, and performing a mock repreſentation of the Eleuſinian myſteries, had in their youth been diſciples of Socrates; and the minds of the populace being thus prepared, a direct accuſation was preferred againſt him before the ſupreme court of judicature. His accuſers were Anytus a leather-dreſſer, who had long entertained a perſonal enmity againſt Socrates, for reprehending his avarice, in depriving his ſons of the benefits of learning, that they might purſue the gains of trade;

Socrates. trade; Melitus, a young rhetorician, who was capable of undertaking any thing for the ſake of gain; and Lycon, who was glad of any opportunity of diſplaying his talents. The accuſation, which was delivered to the ſenate under the name of Melitus, was this: "Melitus, ſon of Melitus, of the tribe of Pythos, accuſeth Socrates, ſon of Sophroniſcus, of the tribe of Alopece. Socrates violates the laws, in not acknowledging the gods which the ſtate acknowledges, and by introducing new divinities. He alſo violates the laws by corrupting the youth. Be his puniſhment DEATH."

This charge was delivered upon oath to the ſenate; and Crito a friend of Socrates became ſurety for his appearance on the day of trial. Anytus ſoon afterwards ſent a private meſſage to Socrates, aſſuring him that if he would deſiſt from cenſuring his conduct, he would withdraw his accuſation. But Socrates refuſed to comply with ſo degrading a condition; and with his uſual ſpirit replied, "Whilſt I live I will never diſguiſe the truth, nor ſpeak otherwiſe than my duty requires." The interval between the accuſation and the trial he ſpent in philoſophical converſations with his friends, chooſing to diſcourſe upon any other ſubject rather than his own ſituation.

When the day of trial arrived, his accuſers appeared in the ſenate, and attempted to ſupport their charge in three diſtinct ſpeeches, which ſtrongly marked their reſpective characters. Plato, who was a young man, and a zealous follower of Socrates, then roſe up to addreſs the judges in defence of his maſter; but whilſt he was attempting to apologiſe for his youth, he was abruptly commanded by the court to ſit down. Socrates, however needed no advocate. Aſcending the chair with all the ſerenity of conſcious innocence, and with all the dignity of ſuperior merit, he delivered, in a firm and manly tone, an unpremeditated defence of himſelf, which ſilenced his opponents, and ought to have convinced his judges. After tracing the progreſs of the conſpiracy which had been raiſed againſt him to its true ſource, the jealouſy and reſentment of men whoſe ignorance he had expoſed, and whoſe vices he had ridiculed and reproved, he diſtinctly replied to the ſeveral charges brought againſt him by Melitus. To prove that he had not been guilty of impiety towards the gods of his country, he appealed to his frequent practice of attending the public religious feſtivals. The crime of introducing new divinities, with which he was charged, chiefly as it ſeems on the ground of the admonitions which he profeſſed to have received from an inviſible power, he diſclaimed, by pleading that it was no new thing for men to conſult the gods and receive inſtructions from them. To refute the charge of his having been a corrupter of youth, he urged the example which he had uniformly exhibited of juſtice, moderation, and temperance; the moral ſpirit and tendency of his diſcourſes; and the effect which had actually been produced by his doctrine upon the manners of the young. Then, diſdaining to ſolicit the mercy of his judges, he called upon them for that juſtice which their office and their oath obliged them to adminiſter; and profeſſing his faith and confidence in God, reſigned himſelf to their pleaſure.

The judges, whoſe prejudices would not ſuffer them to pay due attention to this apology, or to examine with impartiality the merits of the cauſe, immediately declared him guilty of the crimes of which he ſtood accuſed. Socrates, in this ſtage of the trial, had a right to enter his plea againſt the puniſhment which the accuſers demanded, and inſtead of the ſentence of death, to propoſe ſome pecuniary amercement. But he at firſt peremptorily refuſed to make any propoſal of this kind, imagining that it might be conſtrued into an acknowledgment of guilt; and aſſerted, that his conduct merited from the ſtate reward rather than puniſhment. At length, however, he was prevailed upon by his friends to offer upon their credit a fine of thirty *minæ*. The judges, notwithſtanding, ſtill remained inexorable: they proceeded, without farther delay, to pronounce ſentence upon him; and he was condemned to be put to death by the poiſon of hemlock. Socrates.

The ſentence being paſſed, he was ſent to priſon: which, ſays Seneca, he entered with the ſame reſolution and firmneſs with which he had oppoſed the thirty tyrants; and took away all ignominy from the place, which could not be a priſon while he was there. He lay in fetters 30 days; and was conſtantly viſited by Crito, Plato, and other friends, with whom he paſſed the time in diſpute after his uſual manner. Anxious to ſave ſo valuable a life, they urged him to attempt his eſcape, or at leaſt to permit them to convey him away; and Crito went ſo far, as to aſſure him that, by his intereſt with the jailor, it might be eaſily accompliſhed, and to offer him a retreat in Theſſaly; but Socrates rejected the propoſal, as a criminal violation of the laws; and aſked them, whether there was any place out of Attica which death could not reach.

At length the day arrived when the officers to whoſe care he was committed delivered to Socrates early in the morning the final order for his execution, and immediately, according to the law, ſet him at liberty from his bonds. His friends, who came thus early to the priſon that they might have an opportunity of converſing with their maſter through the day, found his wife ſitting by him with a child in her arms. Socrates, that the tranquillity of his laſt moments might not be diſturbed by her unavailing lamentations, requeſted that ſhe might be conducted home. With the moſt frantic expreſſions of grief ſhe left the priſon. An intereſting converſation then paſſed between Socrates and his friends, which chiefly turned upon the immortality of the ſoul. In the courſe of this converſation, he expreſſed his diſapprobation of the practice of ſuicide, and aſſured his friends that his chief ſupport in his preſent ſituation was an expectation, though not unmixed with doubts, of a happy exiſtence after death, "It would be inexcuſable in me (ſaid he) to deſpiſe death, if I were not perſuaded that it will conduct me into the preſence of the gods, who are the moſt righteous governors, and into the ſociety of juſt and good men: but I derive confidence from the hope that ſomething of man remains after death, and that the condition of good men will then be much better than that of the bad." Crito afterwards aſking him, in what manner he wiſhed to be buried? Socrates replied, with a ſmile, "As you pleaſe, provided I do not eſcape out of your hands." Then, turning to the reſt of his friends, he ſaid, "Is it not ſtrange, after all that I have ſaid to convince you that I am going to the ſociety of the hap- Socrates.

Socrates. py, that Crito ſtill thinks that this body, which will ſoon be a lifeleſs corpſe, is Socrates? Let him diſpoſe of my body as he pleaſes, but let him not at its interment mourn over it as if it were Socrates."

Towards the cloſe of the day he retired into an adjoining apartment to bathe; his friends, in the mean time, expreſſing to one another their grief at the proſpect of loſing ſo excellent a father, and being left to paſs the reſt of their days in the ſolitary ſtate of orphans. After a ſhort interval, during which he gave ſome neceſſary inſtructions to his domeſtics, and took his laſt leave of his children, the attendant of the priſon informed him, that the time for drinking the poiſon was come. The executioner, though accuſtomed to ſuch ſcenes, ſhed tears as he preſented the fatal cup. Socrates received it without change of countenance or the leaſt appearance of perturbation: then offering up a prayer to the gods that they would grant him a proſperous paſſage into the inviſible world, with perfect compoſure he ſwallowed the poiſonous draught. His friends around him burſt into tears. Socrates alone remained unmoved. He upbraided their puſillanimity, and entreated them to exerciſe a manly conſtancy worthy of the friends of virtue. He continued walking till the chilling operation of the hemlock obliged him to lie down upon his bed. After remaining for a ſhort time ſilent, he requeſted Crito (probably in order to refute a calumny which might prove injurious to his friends after his deceaſe) not to neglect the offering of a cock which he had vowed to Eſculapius. Then, covering himſelf with his cloak, he expired. Such was the fate of the virtuous Socrates! A ſtory, ſays Cicero, which I never read without tears.

The friends and diſciples of this illuſtrious teacher of wiſdom were deeply afflicted by his death, and attended his funeral with every expreſſion of grief. Apprehenſive, however, for their own ſafety, they ſoon afterwards privately withdrew from the city, and took up their reſidence in diſtant places. Several of them viſited the philoſopher Euclid of Megara, by whom they were kindly received. No ſooner was the unjuſt condemnation of Socrates known through Greece, than a general indignation was kindled in the minds of good men, who univerſally regretted that ſo diſtinguiſhed an advocate for virtue ſhould have fallen a ſacrifice to jealouſy and envy. The Athenians themſelves, ſo remarkable for their caprice, who never knew the value of their great men till after their death, ſoon became ſenſible of the folly as well as criminality of putting to death the man who had been the chief ornament of their city and of the age, and turned their indignation againſt his accuſers. Melitus was condemned to death; and Anytus, to eſcape a ſimilar fate, went into voluntary exile. To give a farther proof of the ſincerity of their regret, the Athenians for a while interrupted public buſineſs; decreed a general mourning; recalled the exiled friends of Socrates; and erected a ſtatue to his memory in one of the moſt frequented parts of the city. His death happened in the firſt year of the 96th olympiad, and in the 70th year of his age.

Socrates left behind him nothing in writing; but his illuſtrious pupils Xenophon and Plato have in ſome meaſure ſupplied this defect. The Memoirs of Socrates, written by Xenophon, afford, however, a much more accurate idea of the opinions of Socrates, and of his manner of teaching, than the Dialogues of Plato, who everywhere mixes his own conceptions and diction with the ideas and language of his maſter. It is related, that when Socrates heard Plato recite his Lyſis, he ſaid, "How much does this young man make me ſay which I never conceived!" Socrates || Sodom.

His diſtinguiſhing character was that of a moral philoſopher; and his doctrine concerning God and religion was rather practical than ſpeculative. But he did not neglect to build the ſtructure of religious faith upon the firm foundation of an appeal to natural appearances: He taught, that the Supreme Being, though inviſible, is clearly ſeen in his works; which at once demonſtrate his exiſtence and his wiſe and benevolent providence. He admitted, beſides the one Supreme Deity, the exiſtence of beings who poſſeſs a middle ſtation between God and man, to whoſe immediate agency he aſcribed the ordinary phenomena of nature, and whom he ſuppoſed to be particularly concerned in the management of human affairs. Hence he declared it to be the duty of every one, in the performance of religious rites, to follow the cuſtoms of his country. At the ſame time, he taught, that the merit of all religious offerings depends upon the character of the worſhipper, and that the gods take pleaſure in the ſacrifices of none but the truly pious.

Concerning the human ſoul, the opinion of Socrates, according to Xenophon, was, that it is allied to the Divine Being, not by a participation of eſſence, but by a ſimilarity of nature; that man excels all other animals in the faculty of reaſon; and that the exiſtence of good men will be continued after death in a ſtate in which they will receive the reward of their virtue. Although it appears that on this latter topic he was not wholly free from uncertainty, the conſolation which he profeſſed to derive from this ſource in the immediate proſpect of death, leaves little room to doubt that he entertained a real expectation of immortality: and there is reaſon to believe that he was the only philoſopher of ancient Greece whoſe principles admitted of ſuch an expectation (ſee METAPHYSICS, Part III. Chap iv.) Of his moral ſyſtem, which was in a high degree pure, and founded on the ſureſt baſis, the reader will find a ſhort view in our article MORAL PHILOSOPHY, n° 4.

SOCRATES was alſo the name of an eccleſiaſtical hiſtorian of the 5th century, born at Conſtantinople in the beginning of the reign of Theodoſius: he profeſſed the law and pleaded at the bar, whence he obtained the name of *Scholaſticus*. He wrote an eccleſiaſtical hiſtory from the year 309, where Euſebius ended, down to 440; and wrote with great exactneſs and judgment. An edition of Euſebius and Socrates, in Greek and Latin, with notes by Reading, was publiſhed at London in 1720.

SODA, the name given by the French chemiſts to the mineral alkali, which is found native in many parts of the world: it is obtained alſo from common ſalt, and from the aſhes of the *kali*, a ſpecies of ſalſola. See ALKALI, n° 7. and CHEMISTRY-*Index*.

SODA is alſo a name for a heat in the ſtomach or heart-burn. See MEDICINE, n° 275.

SODOM, formerly a town of Paleſtine in Aſia, famous in Scripture for the wickedneſs of its inhabitants, and their deſtruction by fire from heaven on account of that

Sodomy, Sodor.

that wickedneſs. The place where it ſtood is now covered by the waters of the Dead Sea, or the Lake Aſphaltites. See ASPHALTITES.

SODOMY, an unnatural crime, ſo called from the city of Sodom, which was deſtroyed by fire for the ſame. The Levitical law adjudged thoſe guilty of this execrable crime to death; and the civil law aſſigns the ſame puniſhment to it. The law of England makes it felony. There is no ſtatute in Scotland againſt Sodomy; the libel of the crime is therefore founded on the divine law, and practice makes its puniſhment to be burned alive.

SODOR, a name always conjoined with Man, in mentioning the biſhop of Man's dioceſe. Concerning the origin and application of this word, very different opinions have been formed by the learned. Buchanan (lib. i. cap. 34.) ſays, that before his time the name of *Sodor* was given to a town in the iſle of Man. In Gough's edition of Camden's *Britannia* (vol. iii. p. 701.) it is ſaid, that after the iſle of Man was annexed to the crown of England, this appellation was given to a ſmall iſland within muſket-ſhot of Man, in which the cathedral ſtands, called by the Norwegians the *Holm*, and by the inhabitants the *Peel*. In ſupport of this opinion a charter is quoted A. D. 1505, in which Thomas earl of Derby and lord of Man confirms to Huan Heſketh biſhop of Sodor all the lands, &c. anciently belonging to the biſhops of Man. "Eccleſiam cathedralem ſancti Germani in *Holm Sodor vel Pele* vocatam, eccleſiam ſancti Patricii ibidem, et locum præfatum in quo eccleſiæ præfatæ ſitæ ſunt." The truth of either, or perhaps of both, theſe accounts might be allowed; but neither of them are ſufficient to account for the conſtant conjunction of Sodor and Man, in charters, regiſters, and hiſtories. If Sodor was a ſmall town or iſland belonging to Man, it cannot be conceived why it is always mentioned before it, or rather why it ſhould be mentioned at all in ſpeaking of a biſhop's dioceſe. To ſpeak of the biſhopric of Sodor and Man in this caſe would be as improper as it would be to call the biſhopric of Durham the biſhopric of Holy Iſland and Durham, or the biſhopric of Darlington and Durham; the former being a ſmall iſland and the latter a town belonging to the county and dioceſe of Durham. Neither of theſe accounts, therefore, give a ſatisfactory account of the original conjunction of Sodor and Man.

The iſland of Iona was the place where the biſhop of the iſles reſided, the cathedral church of which, it is ſaid, was dedicated to our Saviour, in Greek *Soter*, hence *Sotorenſes*, which might be corrupted into *Sodorenſes*, a name frequently given by Daniſh writers to the weſtern iſles of Scotland. That we may be the more diſpoſed to accede to this Grecian etymology, the advocates for this opinion tell us, that the name *Icolumkill*, which is often applied to this iſland, is alſo of Greek extraction, being derived from *Columba*, "a pigeon;" a meaning that exactly correſponds to the Celtic word *Colum* and the Hebrew word *Iona*. We muſt confeſs, however, that we have very little faith in the conjectures of etymologiſts, and think that upon no occaſion they alone can eſtabliſh any fact, though when concurring with facts they certainly tend to confirm and explain them. It is only from hiſtorical facts that we can know to what Sodor was applied.

It appears from the hiſtory of the Orkneys, compiled by an old Iſlandic writer, tranſlated and enlarged by Torfæus, that the Æbudæ or Weſtern iſles of Scotland were divided into two cluſters, Nordureys and Sudereys. The Nordureys, which were ſeparated from the Sudereys by the point of Ardnamurchan, a promontory in Argyleſhire, conſiſted of Muck, Egg, Rum, Canna, Sky, Raſay, Barra, South Uiſt, North Uiſt, Benbecula, and Lewis, including Harris, with a great number of ſmall iſles. The Sudereys were, Man, Arran, Bute, Cumra, Avon, Gid, Ila, Colonſay, Jura, Scarba, Mull, Iona, Tiree, Coll, Ulva, and other ſmall iſlands. All theſe, when joined together, and ſubject to the ſame prince, made up the kingdom of Man and the iſles. In the Norwegian language *Suder* and *Norder*, ſignifying ſouthern and northern, and *ey* or *ay* an iſland. When the Æbudæ were under one monarch, the ſeat of empire was fixed in the Sudereys, and the Nordureys were governed by deputies; hence the former are much oftener mentioned in hiſtory than the latter; hence, too, the Sudereys often comprehend the Nordureys, as in our days Scotland is ſometimes comprehended under England. Sudereys, or Suder, when angliciſed, became Sodor; and all the weſtern iſles of Scotland being included in one dioceſe under the Norwegian princes, the biſhop appointed to ſuperintend them was called the biſhop of Man and the iſles, or the biſhop of Sodor and Man. Since Man was conquered by Edward III. it has been ſeparated from the other iſles, and its biſhops have exerciſed no juriſdiction over them. Should it now be aſked, why then is the biſhop of Man ſtill called the biſhop of Sodor and Man? we reply, that we have been able to diſcover no reaſon; but ſuppoſe the appellation to be continued in the ſame way, as the title king of France, has been kept up by the kings of Great Britain, for ſeveral centuries after the Engliſh were entirely expelled from France.

Sodor || Soffita.

SOFA, in the eaſt, a kind of alcove raiſed half a foot above the floor of a chamber or other apartment; and uſed as the place of ſtate, where viſitors of diſtinction are received. Among the Turks the whole floor of their ſtate-rooms is covered with a kind of tapeſtry, and on the window-ſide is raiſed a ſofa or ſopha, laid with a kind of matraſs, covered with a carpet much richer than the other. On this carpet the Turks are ſeated, both men and women, like the taylors in England, croſs-legged, leaning againſt the wall, which is bolſtered with velvet, ſattin, or other ſtuff ſuitable to the ſeaſon. Here they eat their meals; only laying a ſkin over the carpet to ſerve as a table-cloth, and a round wooden board over all, covered with plates, &c.

SOFALA, or CEFALA, a kingdom of Africa, lying on the coaſt of Moſambique, near Zanguebar. It is bounded on the north by Monomotapa; on the eaſt by the Moſambique Sea; on the ſouth by the kingdom of Sabia; and on the weſt by that of Manica. It contains mines of gold and iron, and a great number of elephants. It is governed by a king, tributary to the Portugueſe, who built a fort at the principal town, which is of the ſame name, and of great importance for their trade to the Eaſt Indies. It is ſeated in a ſmall iſland, near the mouth of a river. E. Long. 35. 40. S. Lat. 20. 20.

SOFFITA, or SOFFIT, in architecture, any timber ceiling formed of croſs beams of flying cornices, the ſquare compartiments or pannels of which are enriched

Soffita || Soho.

with ſculpture, painting, or gilding; ſuch are thoſe in the palaces of Italy, and in the apartments of Luxembourg at Paris.

SOFFITA, or *Soffit*, is alſo uſed for the underſide or face of an architrave; and more particularly for that of the corona or larmier, which the ancients called *lacunar*, the French *plafond*, and we uſually the *drip*. It is enriched with compartments of roſes; and in the Doric order has 18 drops, diſpoſed in three ranks, ſix in each, placed to the right of the guttæ, at the bottom of the triglyphs.

SOFI, or SOPHI. See SOPHI.

SOFTENING, in painting, the mixing and diluting of colours with the bruſh or pencil.

SOHO, the name of a ſet of works, or manufactory of a variety of hard-wares, belonging to Mr Boulton, ſituated on the borders of Staffordſhire, within two miles of Birmingham; now ſo juſtly celebrated as to deſerve a ſhort hiſtorical detail.

About 30 years ago the premiſes conſiſted of a ſmall mill and a few obſcure dwellings. Mr Boulton, in conjunction with Mr Fothergill, then his partner, at an expence of L. 9000, erected a handſome and extenſive edifice, with a view of manufacturing metallic toys. The firſt productions conſiſted of buttons, buckles, watch-chains, trinkets, and ſuch other articles as were peculiar to Birmingham. Novelty, taſte, and variety, were, however, always conſpicuous; and plated wares, known by the name of Sheffield plate, compriſing a great variety of uſeful and ornamental articles, became another permanent ſubject of manufacture.

To open channels for the conſumption of theſe commodities, all the northern part of Europe was explored by the mercantile partner Mr Fothergill. A wide and extenſive correſpondence was thus eſtabliſhed, the undertaking became well known, and the manufacturer, by becoming his own merchant, eventually enjoyed a double profit.

Impelled by an ardent attachment to the arts, and by the patriotic ambition of forming his favourite Soho into a fruitful ſeminary of artiſts, the proprietor extended his views; and men of taſte and talents were now ſought for, and liberally patroniſed. A ſucceſsful imitation of the French *or moulie* ornaments, conſiſting of vaſes, tripods, candelabra, &c. &c. extended the celebrity of the works. Services of plate and other works in ſilver, both maſſive and airy, were added, and an aſſay office was eſtabliſhed in Birmingham.

Mr Watt, the ingenious improver of the ſteam-engine, is now in partnerſhip with Mr Boulton; and they carry on at Soho a manufactory of ſteam-engines, not leſs beneficial to the public than lucrative to themſelves. This valuable machine, the nature and excellences of which are deſcribed in another place (ſee *Steam-Engine*), Mr Boulton propoſed to apply to the operation of coining, and ſuitable apparatus was erected at a great expence, in the hope of being employed by government to make a new copper-coinage for the kingdom. Artiſts of merit were engaged, and ſpecimens of exquiſite delicacy were exhibited; but as no national coinage has taken place, the works are employed upon high finiſhed medals and private coins. To enumerate all the productions of this manufactory would be tedious (A).

Soil, Soiſſons.

In a national view, Mr Boulton's undertakings are highly valuable and important. By collecting around him artiſts of various deſcriptions, rival talents have been called forth, and by ſucceſſive competition have been multiplied to an extent highly beneficial to the public. The manual arts partook of the benefit, and became proportionably improved.

A barren heath has been covered with plenty and population; and Mr Boulton's works, which in their infancy were little known and attended to, now cover ſeveral acres, give employment to more than 600 perſons, and are ſaid to be the firſt of their kind in Europe.

SOIL, the mould covering the ſurface of the earth, in which vegetables grow. It ſerves as a ſupport for vegetables, and as a reſervoir for receiving and communicating their nouriſhment.

Soils are commonly double or triple compounds of the ſeveral reputed primitive earths, except the barytic (ſee EARTHS). The magneſian likewiſe ſparingly occurs. The more fertile ſoils afford alſo a ſmall proportion of coally ſubſtance ariſing from putrefaction, and ſome traces of marine acid and gypſum. The vulgar diviſion into clay, chalk, ſand, and gravel, is well underſtood. Loam denotes any ſoil moderately adheſive; and, according to the ingredient that predominates, it receives the epithets of clayey, chalky, ſandy, or gravelly. The intimate mixture of clay with the oxydes of iron is called *till*, and is of a hard conſiſtence and a dark reddiſh colour. Soils are found by analyſis to contain their earthy ingredients in very different proportions. According to M. Giobert, fertile mould in the vicinity of Turin, where the fall of rain amounts yearly to 40 inches, affords for each 100 parts, from 77 to 79 of ſilex, from 8 to 14 of argill, and from 5 to 12 of calx; beſides about one-half of carbonic matter, and nearly an equal weight of gas, partly carbonic and partly hydrocarbonic. The ſame experimenter repreſents the compoſition of barren ſoils in ſimilar ſituations to be from 42 to 88 *per cent.* of ſilex, from 20 to 30 of argill, and from 4 to 20 of calx. The celebrated Bergman found rich ſoils in the valleys of Sweden, where the annual quantity of rain is 24 inches, to contain, for each 100 parts, 56 of ſiliceous ſand, 14 of argill, and 30 of calx. In the climate of Paris, where the average fall of rain is 20 inches, fertile mixtures, according to M. Tillet, vary from 46 to 52 *per cent.* of ſilex, and from 11 to 17 of argill, with 37 of calx. Hence it appears that in dry countries rich earths are of a cloſer texture, and contain more of the calcareous ingredient, with leſs of the ſiliceous. Mr Arthur Young has diſcovered, that the value of fertile lands is nearly proportioned to the quantities of gas which equal weights of their ſoil afford by diſtillation. See AGRICULTURE, n° 24. and 118.

SOISSONS, an ancient, large, and conſiderable city of France, in the department of Aiſne and late province of Soiſſonnois. It was the capital of a kingdom of the ſame name, under the firſt race of the French monarchs. It contains about 12,000 inhabitants, and is a biſhop's ſee.

(A) It was at this place, in the year 1772, that Mr Eginton invented his expeditious method of copying pictures in oil.

Soke || Solanum.

fee. The environs are charming, but the ſtreets are narrow, and the houſes ill-built. The fine cathedral has one of the moſt conſiderable chapters in the kingdom; and the biſhop, when the archbiſhop of Rheims was abſent, had a right to crown the king. The caſtle, though ancient, is not that in which the kings of the firſt race reſided. Soiſſons is ſeated in a very pleaſant and fertile valley, on the river Aiſne, 30 miles weſt by north of Rheims, and 60 north eaſt of Paris. E. Long. 3. 24. N. Lat. 49. 23.

SOKE, or Sok. See Socage.

SOKEMANS. See Soc and Socage.

SOL, in muſic, the fifth note of the gamut, *ut, re, mi, fa, ſol, la.* See Gamut.

Sol, or *Sou*, a French coin made up of copper mixed with a little ſilver, and is worth upwards of an Engliſh halfpenny, or the 23d part of an Engliſh ſhilling. The ſol when firſt ſtruck was equal in value to 12 deniers Tournois, whence it was alſo called *douzain*, a name it ſtill retains, tho' its ancient value be changed; the ſol having been ſince augmented by three deniers, and ſtruck with a puncheon of a fleur-de-lis, to make it current for 15 deniers. Soon after the old ſols were coined over again, and both old and new were indifferently made current for 15 deniers. In 1709, the value of the ſame ſols was raiſed to 18 deniers. Towards the latter end of the reign of Louis XIV. the ſol of 18 deniers was again lowered to 15; and by the late king it was reduced to the original value of 12. What it is at preſent poſterity may perhaps diſcover.

The Dutch have alſo two kinds of ſols: the one of ſilver, called *ſols de gros*, and likewiſe *ſchelling*; the other of copper, called alſo the *ſtuyver*.

Sol, the *Sun*, in aſtronomy, aſtrology, &c. See Astronomy, *paſſim*.

Sol, in chemiſtry, is gold; thus called from an opinion that this metal is in a particular manner under the influence of the ſun.

Sol, in heraldry, denotes Or, the golden colour in the arms of ſovereign princes.

SOLÆUS, or Soleus, in anatomy, one of the extenſor muſcles of the foot, riſing from the upper and hinder parts of the tibia and fibula.

SOLAN-goose, in ornithology. See Pelicanus.

SOLANDRA, in botany: A genus of plants belonging to the claſs of *monodelphia*, and to the order of *polyandria*; and in the natural ſyſtem arranged under the 38th order, *Tricocceæ*. The calyx is ſimple; the capſule oblong, wreathed, and five-celled; the ſeeds are many, diſpoſed in cells in a double order. The valves after maturity are divaricated, even to the baſe, and winged inwards by the partition. The only ſpecies is the *Lobata*. This genus was firſt named *Solandra*, in honour of Dr Solander, by Murray in the 14th edition of the *Syſtema Vegetabilium*.

SOLANUM, in botany: A genus of the *monogynia* order, belonging to the *pentandria* claſs of plants; and in the natural method ranking under the 28th order, *Luridæ*. The calyx is inferior; the corolla is rotate, and generally monophyllous; the fruit a berry, bilocular, and containing many ſmall and flat ſeeds. Of this genus there are 66 ſpecies, moſt of them natives of the Eaſt and Weſt Indies. The moſt remarkable of which are the following.

1. The *Dulcamara*, a native of Britain and of Africa is a ſlender climbing plant, riſing to ſix or more feet in height. The leaves are generally oval, pointed, and of a deep green colour; the flowers hang in looſe cluſters, of a purple colour, and divided into five pointed ſegments. The calyx is purple, perſiſtent, and divided into five. The five filaments are ſhort, black, and inſerted into the tube of the corolla. The antheræ yellow, erect, and united in a point as uſual in this genus. The ſtyle is long, and terminates in an obtuſe ſtigma. The berry, when ripe, is red, and contains many flat yellowiſh ſeeds. It grows in hedges well ſupplied with water, and flowers about the end of June. On chewing the roots, we firſt feel a bitter, then a ſweet, taſte; hence the name. The berries are ſaid to be poiſonous, and may eaſily be miſtaken by children for currants. The *ſtipites* or younger branches are directed for uſe, and may be employed either freſh or dried: they ſhould be gathered in the autumn. This plant is generally given in decoction or infuſion. Razou directs the following: Take dried dulcamara twigs half a dram, and pour upon it 16 ounces of ſpring water, which muſt be boiled down to 8 ounces; then ſtrain it. Three or four tea ſpoonfuls to be taken every four hours, diluted with milk to prevent its exciting a nauſea. Several authors take notice, that the dulcamara partakes of the milder powers of the nightſhade, joined to a reſolvent and ſaponaceous quality; hence it promotes the ſecretions of urine, ſweat, the menſes, and lochia. It is recommended in a variety of diſorders; but particularly in rheumatiſms, obſtructed menſes, and lochia; alſo in ſome obſtinate cutaneous diſeaſes.

2. The *Nigrum*, common in many places in Britain about dunghills and waſte places. It riſes to about two feet in height. The ſtalk herbaceous, the leaves alternate, irregularly oval, indented, and clothed with ſoft hairs. The flowers are white; the berries black and ſhining. It appears to poſſeſs the deleterious qualities of the other nightſhades in a very high degree, and even the ſmell of the plant is ſaid to cauſe ſleep. The berries are equally poiſonous with the leaves; cauſing *cardialgia*, and *delirium*, and violent diſtortions of the limbs in children. Mr Getaker in 1757 recommended its internal uſe in old ſores, in ſcrofulous and cancerous ulcers, cutaneous eruptions, and in dropſies. He ſays, that one grain infuſed in an ounce of water ſometimes produced a conſiderable effect; that in the doſe of two or three grains it ſeldom failed to evacuate the firſt paſſages, to increaſe very ſenſibly the diſcharges by the ſkin and kidneys, and ſometimes to occaſion headach, drowſineſs, giddineſs, and dimneſs of ſight. Mr Broomfield declares, that in caſes in which he tried this ſolanum, they were much aggravated by it; and that in one caſe in the doſe of one grain it proved mortal to one of his patients; therefore he contends its uſe is prejudicial. This opinion ſeems tacitly to be confirmed, as it is now never given internally. In ancient times it was employed externally as a diſcutient and anodyne in ſome cutaneous affections, tumefactions of the glands, ulcers, and diſorders of the eyes. The *ſolanum nigrum, rubrum*, a native of the Weſt Indies, is called *guma* by the negroes. It is ſo far from having any deleterious quality, that it is daily ſerved up at table as greens or ſpinnage. It has an agreeable bitter taſte.

3. *Lycoperſicum*, the love-apple, or tomato, cultivated in gardens in the warmer parts of Europe and in all tro-

Solanum.

Solanum || Solder.

pical countries. The ſtalk is herbaceous, the leaves pinnated, oval, pointed, and deeply divided. The flowers are on ſimple *racemi:* they are ſmall and yellow. The berry is of the ſize of a plum; they are ſmooth, ſhining, ſoft; and are either of a yellow or reddiſh colour. The tomato is in daily uſe; being either boiled in ſoups or broths, or ſerved up boiled as garniſhes to fleſh-meats.

4. *Melongena*, the egg-plant, or vegetable egg. This is alſo cultivated in gardens, particularly in Jamaica. It ſeldom riſes above a foot in height. The ſtalk is herbaceous and ſmooth; the leaves oval and downy; the flowers are large and blue; the fruit is as big, and very like, the egg of a gooſe. It is often uſed boiled as a vegetable along with animal food or butter, and ſuppoſed to be aphrodiſiac and to cure ſterility.

5. *Longum*. This plant is alſo herbaceous, but grows much ranker than the foregoing. The flowers are blue; and the fruit is ſix or eight inches long, and proportionally thick. It is boiled and eaten at table as the egg-plant.

6. *Tuberoſum*, the common potato. See POTATO.

SOLAR, ſomething belonging to the SUN.

SOLAR-Spots. See ASTRONOMY-*Index*.

SOLDAN. See SULTAN.

SOLDANELLA, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *monogynia;* and in the natural ſyſtem arranged under the 21ſt order, *Preciæ*. The corolla is campanulated; the border being very finely cut into a great many ſegments. The capſule is unilocular, and its apex polydentate.

SOLDER, SODDER, or *Soder*, a metallic or mineral compoſition uſed in ſoldering or joining together other metals.

Solders are made of gold, ſilver, copper, tin, biſmuth, and lead; uſually obſerving, that in the compoſition there be ſome of the metal that is to be ſoldered mixed with ſome higher and finer metals. Goldſmiths uſually make four kinds of ſolder, viz. ſolder of eight, where to ſeven parts of ſilver there is one of braſs or copper; ſolder of ſix, where only a ſixth part is copper; ſolder of four, and ſolder of three. It is the mixture of copper in the ſolder that makes raiſed plate come always cheaper than flat.

As mixtures of gold with a little copper are found to melt with leſs heat than pure gold itſelf, theſe mixtures ſerve as ſolders for gold: two pieces of fine gold are ſoldered by gold that has a ſmall admixture of copper; and gold alloyed with copper is ſoldered by ſuch as is alloyed with more copper: the workmen add a little ſilver as well as copper, and vary the proportions of the two to one another, ſo as to make the colour of the ſolder correſpond as nearly as may be to that of the piece. A mixture of gold and copper is alſo a ſolder for fine copper as well as for fine gold. Gold being particularly diſpoſed to unite with iron, proves an excellent ſolder for the finer kinds of iron and ſteel inſtruments.

The ſolder uſed by plumbers is made of two pounds of lead to one of block-tin. Its goodneſs is tried by melting it, and pouring the bigneſs of a crown-piece on a table; for, if good, there will ariſe little bright ſhining ſtars therein. The ſolder for *copper* is made like that of the plumbers; only with copper and tin; and for very nice works, inſtead of tin, they ſometimes uſe a quantity of ſilver. Solder for *tin* is made of two-thirds of tin and one of lead, or of equal parts of each; but where the work is any thing delicate, as in organ-pipes, where the juncture is ſcarce diſcernible, it is made of one part of biſmuth and three parts of pewter. The pewterers uſe a kind of ſolder made with two parts of tin and one of biſmuth; this compoſition melts with the leaſt heat of any of the ſolders. Soldering.

Silver ſolder is that which is made of two parts of ſilver and one of braſs, and uſed in ſoldering thoſe metals. Spelter ſolder is made of one part of braſs and two of ſpelter or zinc, and is uſed by the braziers and copperſmiths for ſoldering braſs, copper, and iron. This ſolder is improved by adding to each ounce of it one pennyweight of ſilver; but as it does not melt without a conſiderable degree of heat, it cannot be uſed when it is inconvenient to heat the work red-hot; in which caſe copper and braſs are ſoldered with ſilver.

Though ſpelter ſolder be much cheaper than ſilver-ſolder, yet workmen in many caſes prefer the latter. And Mr Boyle informs us, that he has found it to run with ſo moderate a heat, as not much to endanger the melting of the delicate parts of the work to be ſoldered; and if well made, this ſilver ſolder will lie even upon the ordinary kind itſelf; and ſo fill up thoſe little cavities that may chance to be left in the firſt operation, which is not eaſily done without a ſolder more eaſily fuſible than the firſt made uſe of. As to iron, it is ſufficient that it be heated to a white heat, and the two extremities, in this ſtate, be hammered together; by which means they become incorporated one with the other.

SOLDERING, the joining and faſtening together of two pieces of the ſame metal, or of two different metals, by the fuſion and application of ſome metallic compoſition on the extremities of the metals to be joined.

To ſolder upon ſilver, braſs, or iron: Take ſilver, five pennyweights; braſs, four pennyweights; melt them together for ſoft ſolder, which runs ſooneſt. Take ſilver, five pennyweights; copper, three pennyweights; melt them together for hard ſolder. Beat the ſolder thin, and lay it on the place to be ſoldered, which muſt be firſt fitted and bound together with wire as occaſion requires; then take borax in powder, and temper it like pap, and lay it upon the ſolder, letting it dry; then cover it with live coals, and blow, and it will run immediately; take it preſently out of the fire, and it is done. It is to be obſerved, that if any thing is to be ſoldered in two places, which cannot well be done at one time, you muſt firſt ſolder with the harder ſolder, and then with the ſoft; for if it be firſt done with the ſoft, it will unſolder again before the other is faſtened. Let it be obſerved, that if you would not have your ſolder run about the piece that is to be ſoldered, you muſt rub ſuch places over with chalk—In the ſoldering either of gold, ſilver, copper, or either of the metals above mentioned, there is generally uſed borax in powder, and ſometimes roſin. As to iron, it is ſufficient that it be heated red-hot, and the two extremities thus hammered together, by which means they will become incorporated with each other. For the finer kinds of iron and ſteel inſtruments, however, gold proves an excellent ſolder. This metal will diſſolve twice or thrice its weight of iron in a degree of heat very far leſs than that in which iron itſelf melts; hence if a ſmall plate of

gold

Soldier || Solen.

gold is wrapped round the parts to be joined, and afterwards melted by a blow-pipe, it ſtrongly unites the pieces together without any injury to the inſtrument, however delicate.

SOLDIER, a military man liſted to ſerve a prince or ſtate in conſideration of a certain daily pay.

Soldier-Crab. See CANCER.

Freſh Water Soldier. See STRATIOTES.

SOLE, in the manege, a ſort of horn under a horſe's foot, which is much more tender than the other horn that encompaſſes the foot, and by reaſon of its hardneſs is properly called the *horn* or *hoof*.

SOLE, in ichthyology. See PLEURONECTES.

SOLEA. See SANDAL and SHOE.

SOLECISM, in grammar, a falſe manner of ſpeaking, contrary to the rules of grammar, either in reſpect of declenſion, conjugation, or ſyntax.—The word is Greek, σολοικισμος, derived from the *Soli*, a people of Attica, who being tranſplanted to Cilicia, loſt the purity of their ancient tongue, and became ridiculous to the Athenians for the improprieties into which they fell.

SOLEMN, ſomething performed with much pomp, ceremony, and expence. Thus we ſay, ſolemn feaſts, ſolemn funerals, ſolemn games, &c.—In law, *ſolemn* ſignifies ſomething authentic, or what is clothed in all its formalities.

SOLEN, RAZOR-SHEATH, or *Knife-handle Shell*; a genus belonging to the claſs of *vermes*, and order of *teſtacea*. The animal is an aſcidia. The ſhell is bivalve, oblong, and opening at both ſides: the hinge has a tooth ſhaped like an awl, bent back, often double, not inſerted into the oppoſite ſhell; the rim at the ſides ſomewhat worn away, and has a horny cartilaginous hinge. There are 23 ſpecies. Three of them, viz. the ſiliqua, vagina, and enſis, are found on the Britiſh coaſts, and lurk in the ſand near the low-water mark in a perpendicular direction. When in want of food they elevate one end a little above the ſurface, and protrude their bodies far out of the ſhell. On the approach of danger they dart deep into the ſand, ſometimes two feet at leaſt. Their place is known by a ſmall dimple on the ſurface. Sometimes they are dug out with a ſhovel; at other times they are taken by ſtriking a barbed dart ſuddenly into them. When the ſea is down, theſe fiſh uſually run deep into the ſand; and to bring them up, the common cuſtom is to throw a little ſalt into the holes, on which the fiſh raiſes itſelf, and in a few minutes appears at the mouth of its hole. When half the ſhell is diſcovered, the fiſherman has nothing more to do than to take hold of it with his fingers and draw it out: but he muſt be cautious not to loſe the occaſion, for the creature does not continue a moment in that ſtate; and if by any means the fiſherman has touched it, and let it ſlip away, it is gone for ever; for it will not be decoyed again out of its hole by ſalt; ſo that there is then no way of getting it but by digging under it, and throwing it up with the ſand. The fiſh has two pipes, each compoſed of four or five rings or portions of a hollow cylinder, of unequal lengths, joined one to another; and the places where they join are marked by a number of fine ſtreaks or rays. Now the reaſon why the ſalt makes theſe creatures come up out of their holes, is, that it gives them violent pain, and even corrodes theſe pipes. This is ſomewhat ſtrange, as the creature is nouriſhed by means of ſalt-water; but it is very evident, that if a little ſalt be ſtrewed upon theſe pipes in a fiſh taken out of its habitation, it will corrode the joinings of the rings, and often make one or more joints drop off: the creature, to avoid this miſchief, ariſes out of its hole, and throws off the ſalt, and then retires back again. The uſe of theſe pipes to the animal is the ſame with that of many other pipes of a like kind in other ſhell-fiſh; they all ſerve to take in water: they are only a continuation of the outer membrane of the fiſh, and ſerve indifferently for taking in and throwing out the water, one receiving, and the other diſcharging it, and either anſwering equally well to their purpoſe. See *Animal* MOTION.

Soleure, Solfaing.

This fiſh was uſed as food by the ancients; and Athenæus, from Sophron, ſpeaks of it as a great delicacy, and particularly grateful to widows. It is often uſed as food at preſent, and is brought up to table fried in eggs.

SOLEURE, a canton of Swiſſerland, which holds the 11th rank in the Helvetic confederacy, into which it was admitted in the year 1481. It ſtretches partly through the plain, and partly along the chains of the Jura, and contains about 50,000 inhabitants. It is 35 miles in length from north to ſouth, and 35 in breadth from eaſt to weſt. The ſoil for the moſt part is exceedingly fertile in corn; and the diſtricts within the Jura abound in excellent paſtures. The trade both of the town and canton is of little value, although they are very commodiouſly ſituated for an extenſive commerce. It is divided into 11 bailiwicks, the inhabitants of which are all Roman Catholics except thoſe of the bailiwick of Buckegberg, who profeſs the reformed religion. The ſovereign power reſides in the great council, which, compriſing the ſenate or little council of 36, conſiſts of 102 members, choſen by the ſenate in equal proportions from the 11 tribes or companies into which the ancient burghers are diſtributed; and, owing to the diſtinction between the ancient and the new burghers (the former conſiſting of only 85 families) the government is a complete ariſtocracy.

SOLEURE, an ancient and extremely neat town of Swiſſerland, capital of the canton of the ſame name. It contains about 4000 inhabitants, and is pleaſantly ſeated on the Aar, which here expands into a noble river. Among the moſt remarkable objects of curioſity in this town is the new church of St Urs, which was begun in 1762 and finiſhed in 1772. It is a noble edifice of a whitiſh grey ſtone, drawn from the neighbouring quarries, which admits a poliſh, and is a ſpecies of rude marble. The lower part of the building is of the Corinthian, the upper of the Compoſite order. The façade, which conſiſts of a portico, ſurmounted by an elegant tower, preſents itſelf finely at the extremity of the principal ſtreet. It coſt at leaſt L. 80,000, a conſiderable ſum for ſuch a ſmall republic, whoſe revenue ſcarcely exceeds L. 12,000 a year. Soleure is ſurrounded by regular ſtone fortifications, and is 20 miles north north-eaſt of Bern, 27 ſouth ſouth-weſt of Baſle, and 45 weſt of Zurich. E. Long. 7. 20. N. Lat. 47. 15.

SOLFAING, in muſic, the naming or pronouncing the ſeveral notes of a ſong by the ſyllables *ut*, *re*, *mi*, *fa*, *ſol*, &c. in learning to ſing it.

Of the ſeven notes in the French ſcale *ut*, *re*, *mi*, *fa*, *ſol*, *la*, *ſi*, only four are uſed among us in ſinging, as

Solfaing, Solfaterra.

mi, *fa*, *ſol*, *la*: their office is principally, in ſinging, that by applying them to every note of the ſcale, it may not only be pronounced with more eaſe, but chiefly that by them the tones and ſemitones of the natural ſcale may be better marked out and diſtinguiſhed. This deſign is obtained by the four ſyllables *fa*, *ſol*, *la*, *mi*. Thus from *fa* to *ſol* is a tone, alſo from *ſol* to *la*, and from *la* to *mi*, without diſtinguiſhing the greater or leſs tone; but from *la* to *fa*, alſo from *mi* to *fa*, is only a ſemitone. If then theſe be applied in this order, *fa*, *ſol*, *la*, *fa*, *ſol*, *la*, *mi*, *fa*, &c. they expreſs the natural ſeries from C; and if that be repeated to a ſecond or third octave, we ſee by them how to expreſs all the different orders of tones and ſemitones in the diatonic ſcale; and ſtill above *mi* will ſtand *fa*, *ſol*, *la*, and below it the ſame inverted *la*, *ſol*, *fa*, and one *mi* is always diſtant from another an octave; which cannot be ſaid of any of the reſt, becauſe after *mi* aſcending come always *fa*, *ſol*, *la*, which are repeated invertedly deſcending.

To conceive the uſe of this, it is to be remembered, that the firſt thing in learning to ſing, is to make one raiſe a ſcale of notes by tones and ſemitones to an octave, and deſcend again by the ſame; and then to riſe and fall by greater intervals at a leap, as thirds and fourths, &c. and to do all this by beginning at notes of different pitch. Then thoſe notes are repreſented by lines and ſpaces, to which theſe ſyllables are applied, and the learners taught to name each line and ſpace thereby, which makes what we call *ſolfaing*; the uſe whereof is, that while they are learning to tune the degrees and intervals of ſound expreſſed by notes on a line or ſpace, or learning a ſong to which no words are applied, they may not only do it the better by means of articulate ſounds, but chiefly that by knowing the degrees and intervals expreſſed by thoſe ſyllables, they may more readily know the places of the ſemitones, and the true diſtance of the notes. See the article SINGING.

SOLFATERRA, a mountain of Italy in the kingdom of Naples, and Terra di Lavoro. This mountain appears evidently to have been a volcano in ancient times; and the ſoil is yet ſo hot, that the workmen employed there in making alum need nothing elſe beſides the heat of the ground for evaporating their liquids. Of this mountain we have the following account by Sir William Hamilton. "Near Aſtruni (another mountain, formerly a volcano likewiſe) riſes the Solfaterra, which not only retains its cone and crater, but much of its former heat. In the plain within the crater, ſmoke iſſues from many parts, as alſo from its ſides: here, by means of ſtones and tiles heaped over the crevices, through which the ſmoke paſſes, they collect in an aukward manner what they call *ſale armoniaco*; and from the ſand of the plain they extract ſulphur and alum. This ſpot, well attended to, might certainly produce a good revenue, whereas I doubt if they have hitherto ever cleared L. 200 a-year by it. The hollow ſound produced by throwing a heavy ſtone on the plain of the crater of the Solfaterra, ſeems to indicate that it is ſupported by a ſort of arched natural vault; and one is induced to think that there is a pool of water beneath this vault (which boils by the heat of a ſubterraneous fire ſtill deeper), by the very moiſt ſteam that iſſues from the cracks in the plain of the Solfaterra, which, like that of boiling water, runs off a ſword or knife, preſented to it, in great drops. On the outſide, and at the foot of the cone of the Solfaterra, towards the lake of Agnano, water ruſhes out of the rocks ſo hot as to raiſe the quickſilver in Fahrenheit's thermometer to the degree of boiling water (A); a fact of which I was myſelf an eye-witneſs. This place, well worthy the obſervation of the curious, has been taken little notice of; it is called the *Piſciarelli*. The common people of Naples have great faith in the efficacy of this water; and make much of it in all cutaneous diſorders, as well as for another diſorder that prevails here. It ſeems to be impregnated chiefly with ſulphur and alum. When you approach your ear to the rocks of the Piſciarelli, from whence this water ouzes, you hear a horrid boiling noiſe, which ſeems to proceed from the huge cauldron that may be ſuppoſed to be under the plain of the Solfaterra. On the other ſide of the Solfaterra, next the ſea, there is a rock which has communicated with the ſea, till part of it was cut away to make the road to Puzzole; this was undoubtedly a conſiderable lava, that ran from the Solfaterra when it was an active volcano. Under this rock of lava, which is more than 70 feet high, there is a ſtratum of pumice and aſhes. This ancient lava is about a quarter of a mile broad; you meet with it abruptly before you come in ſight of Puzzole, and it finiſhes as abruptly within about 100 paces of the town. The ancient name of the Solfaterra was *Forum Vulcani*; a ſtrong proof of its origin from ſubterraneous fire. The degree of heat that the Solfaterra has preſerved for ſo many ages, ſeems to have calcined the ſtones upon its cone and in its crater, as they are very white and crumble eaſily in the hotteſt parts. See CHEMISTRY, n° 656.

Solfaterra ‖ Solid.

SOLICITOR, a perſon employed to take care of and manage ſuits depending in the courts of law or equity. Solicitors are within the ſtatute to be ſworn, and admitted by the judges, before they are allowed to practiſe in our courts, in like manner as attorneys.

There is alſo a great officer of the law, next to the attorney-general, who is ſtyled the king's ſolicitor-general; who holds his office by patent during the king's pleaſure, has the care and concern of managing the king's affairs, and has fees for pleading, beſides other fees ariſing by patents, &c. He attends on the privy-council; and the attorney-general and he were anciently reckoned among the officers of the exchequer; they have their audience, and come within the bar in all other courts.

SOLID, in philoſophy, a body whoſe parts are ſo firmly

(A) "I have remarked, that after a great fall of rain, the degree of heat in this water is much leſs; which will account for what Padre Torre ſays (in his book, intitled *Hiſtoire et Phenomenes du Veſuve*), that when he tried it in company with Monſieur de la Condamine, the degree of heat, upon Reaumur's thermometer, was 68°.

Solids || Solidity.

firmly connected together, as not eaſily to give way or ſlip from each other; in which ſenſe *ſolid* ſtands oppoſed to *fluid*.

Geometricians define a ſolid to be the third ſpecies of magnitude, or that which has three dimenſions, viz. length, breadth, and thickneſs or depth.

Solids are commonly divided into regular and irregular. The regular ſolids are thoſe terminated by regular and equal planes, and are only five in number, viz. the tetrahedron, which conſiſts of four equal triangles; the cube or hexahedron, of ſix equal ſquares; the octahedron, of eight equal triangles; the dodecahedron, of twelve; and the icoſihedron, of twenty equal triangles.

The irregular ſolids are almoſt infinite, comprehending all ſuch as do not come under the definition of regular ſolids; as the ſphere, cylinder, cone, parallelogram, priſm, parallelopiped, &c.

SOLIDS, in anatomy, are the bones, ligaments, membranes, muſcles, nerves and veſſels, &c.

The ſolid parts of the body, though equally compoſed of veſſels, are different with regard to their conſiſtence; ſome being hard and others ſoft. The hard, as the bones and cartilages, give firmneſs and attitude to the body, and ſuſtain the other parts: the ſoft parts, either alone or together with the hard, ſerve to execute the animal functions. See ANATOMY.

SOLIDAGO, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and to the order of *polygamia ſuperflua*; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. The receptacle is naked; the pappus ſimple; the radii are commonly five; the ſcales of the calyx are imbricated and curved inward. There are 14 ſpecies; ſempervirens, canadenſis, altiſſima, lateriflora, bicolor, lanceolata, cœſia, mexicana, flexicaulis, latifolia, virgaurea, minuta, rigida, noveboracenſis. Among theſe there is only one ſpecies, which is a native of Britain, the *virgaurea*, or golden rod, which grows frequently in rough mountainous paſtures and woods. The ſtems are branched, and vary from ſix inches to five feet high, but their common height is about a yard. The leaves are a little hard and rough to the touch; the lower ones oval-lanceolate, generally a little ſerrated and ſupported on footſtalks; thoſe on the ſtalks are elliptical; the flowers are yellow, and grow in ſpikes from the alæ of the leaves; the ſcales of the calyx are lanceolate, of unequal length, and of a pale green colour; the female florets in the rays are from five to eight in number; the hermaphrodite flowers in the diſc from ten to twelve. There is a variety of this ſpecies called *cambrica* to be found on rocks from ſix inches to a foot high.

SOLIDITY, that property of matter, or body, by which it excludes all other bodies from the place which itſelf poſſeſſes; and as it would be abſurd to ſuppoſe that two bodies could poſſeſs one and the ſame place at the ſame time, it follows, that the ſofteſt bodies are equally ſolid with the hardeſt. See METAPHYSICS, n° 44. 173. &c.

Among geometricians, the ſolidity of a body denotes the quantity or ſpace contained in it, and is called alſo its ſolid content.

The ſolidity of a cube, priſm, cylinder, or parallelopiped, is had by multiplying its baſis into its height. The ſolidity of a pyramid or cone is had by multiplying either the whole baſe into a third part of the height, or the whole height into a third part of the baſe.

Soliloquy. Sol'man.

SOLILOQUY, a reaſoning or diſcourſe which a man holds with himſelf; or, more properly, according to Papias, it is a diſcourſe by way of anſwer to a queſtion that a man propoſes to himſelf.

Soliloquies are become very common on the modern ſtage; yet nothing can be more inartificial, or more unnatural, than an actor's making long ſpeeches to himſelf, to convey his intentions to the audience. Where ſuch diſcoveries are neceſſary to be made, the poet ſhould rather take care to give the dramatic perſons ſuch confidants as may neceſſarily ſhare their inmoſt thoughts; by which means they will be more naturally conveyed to the audience; yet even this is a ſhift which an accurate poet would not have occaſion for. The following lines of the duke of Buckingham concerning the uſe and abuſe of ſoliloquies deſerve attention:

Soliloquies had need be very few,
Extremely ſhort, and ſpoke in paſſion too.
Our lovers talking to themſelves, for want
Of others, make the pit their confidant:
Nor is the matter mended yet, if thus
They truſt a friend, only to tell it us.

SOLIMAN II. emperor of the Turks, ſurnamed the *Magnificent*, was the only ſon of Selim I. whom he ſucceeded in 1520. He was educated in a manner very different from the Ottoman princes in general; for he was inſtructed in the maxims of politics and the ſecrets of government. He began his reign by reſtoring thoſe perſons their poſſeſſions whom his father had unjuſtly plundered. He re-eſtabliſhed the authority of the tribunals, which was almoſt annihilated, and beſtowed the government of provinces upon none but perſons of wealth and probity: "I would have my viceroys (he uſed to ſay) reſemble thoſe rivers that fertilize the fields through which they paſs, not thoſe torrents which ſweep every thing before them."

After concluding a truce with Iſmael Sophy of Perſia, and ſubduing Gozeli Bey, who had raiſed a rebellion in Syria, he turned his arms againſt Europe. Belgrade was taken in 1521, and Rhodes fell into his hands the year following, after an obſtinate and enthuſiaſtic defence. In 1526 he defeated and ſlew the king of Hungary in the famous battle of Mohatz. Three years after he conquered Buda, and immediately laid ſiege to Vienna itſelf. But after continuing 20 days before that city, and aſſaulting it 20 times, he was obliged to retreat with the loſs of 80,000 men. Some time after he was defeated by the Perſians, and diſappointed in his hopes of taking Malta. He ſucceeded, however, in diſpoſſeſſing the Genoeſe of Chio, an iſland which had belonged to that republic for more than 200 years.

He died at the age of 76, while he was beſieging Sigeth, a town in Hungary, on the 30th Auguſt 1566.

He was a prince of the ſtricteſt probity, a lover of juſtice, and vigorous in the execution of it; but he tarniſhed all his glory by the cruelty of his diſpoſition. After the battle of Mohatz he ordered 1500 priſoners, moſt of them gentlemen, to be ranged in a circle, and beheaded in preſence of his whole army.

Solipuga || Solomon.

Soliman thought nothing impoſſible which he commanded: A general having received orders to throw a bridge over the Drave, wrote him, that it was impoſſible. The ſultan ſent him a long band of linen with theſe words written on it: "The emperor Soliman, thy maſter, orders thee to build a bridge over the Drave in ſpite of the difficulties thou mayeſt meet with. He informs thee at the ſame time, that if the bridge be not finiſhed upon his arrival, he will hang thee with the very linen which informs thee of his will."

SOLIPUGA, or SOLIFUGA, in natural hiſtory, the name given by the Romans to a ſmall venomous inſect of the ſpider-kind, called by the Greeks *heliocentros*; both words ſignifying an animal which ſtings moſt in the country, and ſeaſons where the ſun is moſt hot. Solinus makes this creature peculiar to Sardinia; but this is contrary to all the accounts given us by the ancients. It is common in Africa and ſome parts of Europe. Almoſt all the hot countries produce this venomous little creature. It lies under the ſand to ſeize other inſects as they go by; and if it meet with any uncovered part of a man, produces a wound which proves very painful: it is ſaid that the bite is abſolutely mortal, but probably this is not true. Solinus writes the word *ſolifuga*, and ſo do many others, erroneouſly deriving the name from the notion that this animal flies from the ſun's rays, and buries itſelf in the ſand.

SOLIS (Antonio de), an ingenious Spaniſh writer, of an ancient and illuſtrious family, born at Placenza in Old Caſtile, in 1610. He was intended for the law; but his inclination toward poetry prevailed, and he cultivated it with great ſucceſs. Philip IV. of Spain made him one of his ſecretaries; and after his death the queen-regent appointed him hiſtoriographer of the Indies, a place of great profit and honour: his Hiſtory of the Conqueſt of Mexico ſhows that ſhe could not have named a fitter perſon. He is better known by this hiſtory at leaſt abroad, than by his poetry and dramatic writings, though in theſe he was alſo diſtinguiſhed. He turned prieſt at 57 years of age, and died in 1686.

SOLITARY, that which is remote from the company or commerce of others of the ſame ſpecies.

SOLITARIES, a denomination of nuns of St Peter of Alcantara, inſtituted in 1676, the deſign of which was to imitate the ſevere penitent life of that ſaint. Thus they are to keep a continual ſilence, never to open their mouths to a ſtranger; to employ their time wholly in ſpiritual exerciſes, and leave their temporal concerns to a number of maids, who have a particular ſuperior in a ſeparate part of the monaſtery: they always go bare-footed, without ſandals; gird themſelves with a thick cord, and wear no linen.

SOLO, in the Italian muſic, is frequently uſed in pieces conſiſting of ſeveral parts, to mark thoſe that are to perform alone; as *fiauto ſolo*, *violino ſolo*. It is alſo uſed for ſonatas compoſed for one violin, one German flute, or other inſtrument, and a baſs; thus we ſay, *Corelli's ſolos*, *Geminiani's ſolos*, &c. When two or three parts play or ſing ſeparately from the grand chorus, they are called a *doi ſoli*, a *tre ſoli*, &c. Solo is ſometimes denoted by *S*.

SOLOMON, the ſon of David king of Iſrael, renowned in Scripture for his wiſdom, riches, and magnificent temple and other buildings. Towards the end of his life he ſullied all his former glory by his apoſtacy from God; from which cauſe vengeance was denounced againſt his houſe and nation. He died about 975 B. C. Solomon, Solon.

Solomon's Seal, in botany; a ſpecies of CONVALLARIA.

SOLON, one of the ſeven wiſe men of Greece, was born at Salamis, of Athenian parents, who were deſcended from Codrus. His father leaving little patrimony, he had recourſe to merchandiſe for his ſubſiſtence. He had, however, a greater thirſt after knowledge and fame than after riches, and made his mercantile voyages ſubſervient to the increaſe of his intellectual treaſures. He very early cultivated the art of poetry, and applied himſelf to the ſtudy of moral and civil wiſdom. When the Athenians, tired out with a long and troubleſome war with the Megarenſians, for the recovery of the iſle of Salamis, prohibited any one, under pain of death, to propoſe the renewal of their claim to that iſland, Solon thinking the prohibition diſhonourable to the ſtate, and finding many of the younger citizens deſirous to revive the war, feigned himſelf mad, and took care to have the report of his inſanity ſpread thro' the city. In the mean time he compoſed an elegy adapted to the ſtate of public affairs, which he committed to memory. Every thing being thus prepared, he ſallied forth into the market-place with the kind of cap on his head which was commonly worn by ſick perſons, and, aſcending the herald's ſtand, he delivered, to a numerous crowd, his lamentation for the deſertion of Salamis. The verſes were heard with general applauſe; and Piſiſtratus ſeconded his advice, and urged the people to renew the war. The decree was immediately repealed; the claim to Salamis was reſumed; and the conduct of the war was committed to Solon and Piſiſtratus, who, by means of a ſtratagem, defeated the Megarenſians, and recovered Salamis.

His popularity was extended through Greece in conſequence of a ſucceſsful alliance which he formed among the ſtates in defence of the temple at Delphos againſt the Cirrhæans. When diſſenſions had ariſen at Athens between the rich creditors and their poor debtors, Solon was created archon, with the united powers of ſupreme legiſlator and magiſtrate. He ſoon reſtored harmony between the rich and poor: He cancelled the debts which had proved the occaſion of ſo much oppreſſion, and ordained that in future no creditor ſhould be allowed to ſeize the body of the debtor for his ſecurity: He made a new diſtribution of the people, inſtituted new courts of judicature, and framed a judicious code of laws, which afterwards became the baſis of the laws of the twelve tables in Rome. Among his criminal laws are many wiſe and excellent regulations; but the code is neceſſarily defective with reſpect to thoſe principles which muſt be derived from the knowledge of the true God, and of pure morality, as the certain foundations of national happineſs. Two of them in particular were very exceptionable; the permiſſion of a voluntary exile to perſons that had been guilty of premeditated murder, and the appointment of a leſs ſevere puniſhment for a rape than for ſeduction. Thoſe who wiſh to ſee accurately ſtated the comparative excellence of the laws of Moſes, of Lycurgus, and Solon, may conſult Prize Diſſertations relative to Natural and Revealed Religion by Teyler's Theological Society, Vol. IX.

The interview which Solon is ſaid to have had with Crœſus

Solſtice || Sombrero.

Croeſus king of Lydia, the ſolid remarks of the ſage after ſurveying the monarch's wealth, the recollection of thoſe remarks by Croeſus when doomed to die, and the noble conduct of Cyrus on that occaſion, are known to every ſchoolboy. Solon died in the iſland of Cyprus, about the 80th year of his age. Statues were erected to his memory both at Athens and Salamis. His thirſt after knowledge continued to the laſt: "I grow old (ſaid he) learning many things." Among the apothegms and precepts which have been aſcribed to Solon, are the following: Laws are like cobwebs, that entangle the weak, but are broken through by the ſtrong. He who has learned to obey, will know how to command. In all things let reaſon be your guide. Diligently contemplate excellent things. In every thing that you do, conſider the end.

SOLSTICE, in aſtronomy, that time when the ſun is in one of the ſolſtitial points; that is, when he is at his greateſt diſtance from the equator; thus called becauſe he then appears to ſtand ſtill, and not to change his diſtance from the equator for ſome time; an appearance owing to the obliquity of our ſphere, and which thoſe living under the equator are ſtrangers to.

The ſolſtices are two in each year; the æſtival or ſummer ſolſtice, and the hyemal or winter ſolſtice. The ſummer ſolſtice is when the ſun ſeems to deſcribe the tropic of cancer, which is on June 22. when he makes the longeſt day: the winter ſolſtice is when the ſun enters the firſt degree, or ſeems to deſcribe the tropic of capricorn, which is on December 22. when he makes the ſhorteſt day. This is to be underſtood as in our northern hemiſphere; for in the ſouthern, the ſun's entrance into capricorn makes the ſummer ſolſtice, and that into cancer the winter ſolſtice. The two points of the ecliptic, wherein the ſun's greateſt aſcent above the equator, and his deſcent below it, are terminated, are called the *ſolſtitial points*; and a circle, ſuppoſed to paſs through the poles of the world and theſe points, is called the *ſolſtitial colure*. The ſummer ſolſtitial point is in the beginning of the firſt degree of cancer, and is called the *æſtival* or *ſummer point*; and the winter ſolſtitial point is in the beginning of the firſt degree of capricorn, and is called the *winter point*. Theſe two points are diametrically oppoſite to each other.

SOLUTION, in chemiſtry, denotes an intimate union of ſolid with fluid bodies, ſo as to form a tranſparent liquor. See DISSOLUTION, and *Index* to CHEMISTRY.

Solution of Metals. See *METALS (Solution of)*.

SOLVENT, that which diſſolves a ſolid body into a tranſparent fluid.

SOLWAY MOSS. See *Moving Moss*.

SOMBRERO, the name of an uninhabited iſland in the Weſt Indies in the form of an hat, whence the name is derived. It is alſo the name of one of the Nicobar iſlands in the Eaſt Indies.

Wonderful Plant of SOMBRERO, is a ſtrange kind of ſenſitive plant growing in the Eaſt Indies, in ſandy bays and in ſhallow water. It appears like a ſlender ſtraight ſtick; but when you attempt to touch it, immediately withdraws itſelf into the ſand. Mr Miller gives an account of it in his deſcription of Sumatra. He ſays, the Malays call it *lulan lout*, that is, ſea graſs. He never could obſerve any tentacula; but, after many unſucceſsful attempts, drew out a broken piece about a foot long. It was perfectly ſtraight and uniform, and reſembled a worm drawn over a knitting needle. When dry it appears like a coral.

Philoſophical Tranſactions vol. lxv. ii. p. 178.

Somers, Somerſetſhire.

SOMERS (John), lord high chancellor of England, was born at Worceſter in 1652. He was educated at Oxford, and afterwards entered himſelf at the Middle-Temple, where he ſtudied the law with great vigour. In 1688 he was one of the counſel for the ſeven biſhops at their trial, and argued with great learning and eloquence againſt the diſpenſing power. In the convention which met by the prince of Orange's ſummons, January 22. 1689, he repreſented Worceſter; and was one of the managers for the Houſe of Commons, at a conference with the Houſe of Lords upon the word *abdicated*. Soon after the acceſſion of King William and Queen Mary to the throne, he was appointed ſolicitor-general, and received the honour of knighthood. In 1692 he was made attorney general, and in 1693 advanced to the poſt of lord keeper of the great ſeal of England. In 1695 he propoſed an expedient to prevent the practice of clipping the coin. In 1697 he was created lord Somers, baron of Eveſham, and made lord high chancellor of England. In the beginning of 1700 he was removed from his poſt of lord chancellor, and the year after was impeached of high crimes and miſdemeanors by the Houſe of Commons, of which he was acquitted upon trial by the Houſe of Lords. He then retired to a ſtudious courſe of life, and was choſen preſident of the Royal Society. In 1706 he propoſed a bill for the regulation of the law; and the ſame year was one of the principal managers for the union between England and Scotland. In 1708 he was made lord preſident of the council; from which poſt he was removed in 1710, upon the change of the miniſtry. In the latter end of Queen Anne's reign his lordſhip grew very infirm in his health; which is ſuppoſed to be the reaſon that he held no other poſt than a ſeat at the council-table, after the acceſſion of King George I. He died of an apoplectic fit in 1716. Mr Addiſon has drawn his character very beautifully in the Freeholder.

SOMERSETSHIRE, a county of England, taking its name from Somerton, once the capital, between 50° and 51° 27′ north latitude, and between 1° 25′ and 2° 59′ weſt longitude. It is bounded on the weſt by Devonſhire, on the ſouth by Dorſetſhire, on the north by Briſtol Channel or the Severn Sea, on the north-eaſt by a ſmall part of Glouceſterſhire, and on the eaſt by Wiltſhire. It is one of the largeſt counties in England, extending in length from eaſt to weſt about 68 miles; in breadth, where broadeſt, from ſouth to north, about 47; and 240 in circumference. It is divided into 42 hundreds, in which are 3 cities, 32 market-towns, 1700 villages, 385 pariſhes of which 132 are vicarages, containing more than 1,000,000 of acres, and about 300,000 ſouls. It ſends 18 members to Parliament, viz. two for the county, two for Briſtol, two for Bath, two for Wells, two for Taunton, two for Bridgewater, two for Ilcheſter, two for Milbourn-port, and two for Minehead.

The air of this county is very mild and wholeſome, eſpecially that of the hilly part. The ſoil in general is exceeding rich, ſo that ſingle acres very commonly produce forty or fifty buſhels of wheat, and there have been inſtances of ſome producing ſixty of barley. As there is very fine paſture both for ſheep and black cattle, it abounds in both, which are as large as thoſe of

Somerſetſhire || Sonata.

Lincolnſhire, and their fleſh of a finer grain. In conſequence of this abundance of black cattle, great quantities of cheeſe are made in it, of which that of Cheddar is thought equal to Parmeſan. In the hilly parts are found coal, lead, copper, and lapis calaminaris. Wood thrives in it as well as in any county of the kingdom. It abounds alſo in peaſe, beans, beer, cyder, fruit, wildfowl, and ſalmon; and its mineral waters are celebrated all over the world.

The riches of this county, both natural and acquired, exceed thoſe of any other in the kingdom, Middleſex and Yorkſhire excepted. The woollen manufacture in all its branches is carried on to a very great extent; and in ſome parts of the county great quantities of linen are made. If to theſe the produce of various other commodities in which it abounds is added, the amount of the whole muſt undoubtedly be very great. Its foreign trade muſt alſo be allowed to be very extenſive, when it is conſidered that it has a large trade for ſea coal, and poſſeſſes, beſides other ports, that of Briſtol, a town of the greateſt trade in England, next to London.

Beſides ſmall ſtreams, it is well watered and ſupplied with fiſh by the rivers Severn, Avon, Parrel, Froome, Ax, Torre, and Tone. Its greateſt hills are Mendip, Pouldon, and Quantock, of which the firſt abounds in coal, lead, &c. The rivers Severn and Parrel breed very fine ſalmon. The chief town is Briſtol.

SOMERTON, an ancient town in Somerſetſhire, from whence the county derives its name. It is 123 miles from London; it has five ſtreets, containing 251 houſes, which are moſtly built of the blue ſtone from the quarries in the neighbourhood. It is governed by conſtables, and has a hall for petty ſeſſions. The market for corn is conſiderable, and it has ſeveral fairs for cattle. The church has what is not very frequent, an *octangular* tower with ſix bells. N. Lat. 51.4. W. Long. 1. 53.

SOMNAMBULI, perſons who walk in their ſleep. See SLEEPWALKERS.

SOMNER (William), an eminent Engliſh antiquary, was born at Canterbury in 1606. His firſt treatiſe was The Antiquities of Canterbury, which he dedicated to Archbiſhop Laud. He then applied himſelf to the ſtudy of the Saxon language; and having made himſelf maſter of it, he perceived that the old gloſſary prefixed to Sir Roger Twiſden's edition of the laws of King Henry I. printed in 1644, was faulty in many places; he therefore added to that edition notes and obſervations valuable for their learning, with a very uſeful gloſſary. His Treatiſe of Gavelkind was finiſhed about 1648, though not publiſhed till 1660. Our author was zealouſly attached to King Charles I. and in 1648 he publiſhed a poem on his ſufferings and death. His ſkill in the Saxon tongue led him to inquire into moſt of the European languages ancient and modern. He aſſiſted Dugdale and Dodſworth in compiling the *Monaſticon Anglicanum*. His Saxon Dictionary was printed at Oxford in 1659. He died in 1669.

SON, an appellation given to a male child conſidered in the relation he bears to his parents. See PARENT and FILIAL *Piety*.

SONATA, in muſic, a piece or compoſition, intended to be performed by inſtruments only; in which ſenſe it ſtands oppoſed to *cantata*, or a piece deſigned for the voice. See CANTATA. Sonata, Sonchus.

The ſonata then, is properly a grand, free, humorous compoſition, diverſified with a great variety of motions and expreſſions, extraordinary and bold ſtrokes, figures, &c. And all this purely according to the fancy of the compoſer; who, without confining himſelf to any general rules of counterpoint, or to any fixed number or meaſure, gives a looſe to his genius, and runs from one mode, meaſure, &c. to another, as he thinks fit. This ſpecies of compoſition had its riſe about the middle of the 17th century; thoſe who have moſt excelled in it were Baſſani and Corelli. We have ſonatas of 1, 2, 3, 4, 5, 6, 7, and even 8 parts, but uſually they are performed by a ſingle violin, or with two violins, and a thorough baſs for the harpſichord; and frequently a more figured baſs for the baſs viol, &c.

There are a thouſand different ſpecies of ſonatas; but the Italians uſually reduce them to two kinds. *Suonate de chieſa*, that is, ſonatas proper for church muſic, which uſually begin with a grave ſolemn motion, ſuitable to the dignity and ſanctity of the place and the ſervice, after which they ſtrike into a briſker, gayer, and richer manner. Theſe are what they more peculiarly call ſonatas. *Suonate de camera*, or ſonatas for the chamber, are properly ſerieſes of ſeveral little pieces, for dancing, only compoſed to the ſame tune. They uſually begin with a prelude or little ſonata, ſerving as an introduction to all the reſt: afterwards come the allemand, pavane, courant, and other ſerious dances; then jigs, gavots, minuets, chacons, paſſecailles, and other gayer airs: the whole compoſed in the ſame tune or mode.

SONCHUS, SOW-THISTLE, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and to the order of *polygamia æqualis*; and in the natural ſyſtem ranged under the 49th order, *Compoſitæ*. The receptacle is naked; the calyx is imbricated, bellying and conical; the down of the ſeed is ſimple, ſeſſile, and very ſoft; the ſeed is oval and pointed. There are 13 ſpecies; the maritimus, paluſtris, fruticoſus, arvenſis, oleraceus, tenerrimus, plumieri, alpinus, floridanus, ſibiricus, tataricus, tuberoſus, and canadenſis. Four of theſe are natives of Britain.—1. *Paluſtris*, marſh ſow-thiſtle. The ſtem is erect, from ſix to ten feet high, branched and hairy towards the top: the leaves are firm, broad, half pinnated, ſerrated, and ſharp-pointed; the lower ones ſagittate at the baſe: the flowers are of a deep yellow, large, and diſperſed on the tops of the branches: the calyx is rough. It is frequent in marſhes, and flowers in July or Auguſt.—2. *Arvenſis*, corn ſow-thiſtle. The leaves are alternate, runcinate, and heart-ſhaped at the baſe; the root creeps under ground; the ſtem is three or four feet high, and branched at the top. It grows in corn-fields, and flowers in Auguſt.—3. *Oleraceus*, common ſow-thiſtle. The ſtalk is ſucculent, piſtular, and a cubit high or more; the leaves are broad, embracing the ſtem, generally deeply ſinuated, ſmooth or prickly at the edges; the flowers are of a pale yellow, numerous, in a kind of umbel, and terminal; the calyx is ſmooth. It is frequent in waſte places and cultivated grounds.—4. *Alpinus*, blue-flowered ſow-thiſtle. The ſtem is erect, purpliſh, branched, or ſimple, from three to ſix feet high: the leaves are large, ſmooth, and ſinuated;

Song. ated; the extreme ſegment large and triangular: the flowers are blue, and grow on hairy viſcid pedicles, in long ſpikes: the calyx is brown. This ſpecies is found in Northumberland.

SONG, in poetry, a little compoſition, conſiſting of eaſy and natural verſes, ſet to a tune in order to be ſung. See POETRY, n° 120.

SONG, in muſic, is applied in general to a ſingle piece of muſic, whether contrived for the voice or an inſtrument. See AIR.

SONG of Birds, is defined by the honourable Daines Barrington to be a ſucceſſion of three or more different notes, which are continued without interruption, during the ſame interval, with a muſical bar of four crotchets in an adagio movement, or whilſt a pendulum ſwings four ſeconds.

It is affirmed, that the notes of birds are no more innate than language in man, and that they depend upon imitation, as far as their organs will enable them to imitate the ſounds which they have frequent opportunities of hearing: and their adhering ſo ſteadily, even in a wild ſtate, to the ſame ſong, is owing to the neſtlings attending only to the inſtruction of the parent bird, whilſt they diſregard the notes of all others that may perhaps be ſinging round them.

Birds in a wild ſtate do not commonly ſing above 10 weeks in the year, whereas birds that have plenty of food in a cage ſing the greateſt part of the year: and we may add, that the female of no ſpecies of birds ever ſings. This is a wiſe proviſion of nature, becauſe her ſong would diſcover her neſt. In the ſame manner, we may rationally account for her inferiority in plumage. The faculty of ſinging is confined to the cock birds; and accordingly Mr Hunter, in diſſecting birds of ſeveral ſpecies, found the muſcles of the larynx to be ſtronger in the nightingale than in any other bird of the ſame ſize; and in all thoſe inſtances, where he diſſected both cock and hen, the ſame muſcles were ſtronger in the cock. To the ſame purpoſe, it is an obſervation as ancient as the time of Pliny, that a capon does not crow.

Some have aſcribed the ſinging of the cock-bird in the ſpring ſolely to the motive of pleaſing his mate during incubation; others, who allow that it is partly for this end, believe it is partly owing alſo to another cauſe, viz. the great abundance of plants and inſects in the ſpring, which, as well as ſeeds, are the proper food of ſinging birds at that time of the year.

Mr Barrington remarks, that there is no inſtance of any ſinging bird which exceeds our blackbird in ſize; and this, he ſuppoſes, may ariſe from the difficulty of its concealing itſelf, if it called the attention of its enemies, not only by its bulk, but by the proportionable loudneſs of its notes. This writer farther obſerves, that ſome paſſages of the ſong in a few kinds of birds correſpond with the intervals of our muſical ſcale, of which the cuckoo is a ſtriking and known inſtance; but the greater part of their ſong cannot be reduced to a muſical ſcale; partly, becauſe the rapidity is often ſo great, and it is alſo ſo uncertain when they may ſtop, that we cannot reduce the paſſages to form a muſical bar in any time whatſoever; partly alſo, becauſe the pitch of moſt birds is conſiderably higher than the moſt ſhrill notes of thoſe inſtruments which have the greateſt compaſs; and principally, becauſe the intervals uſed by birds are commonly ſo minute, that we cannot judge of them from the more groſs intervals into which we divide our muſical octave. This writer apprehends, that all birds ſing in the ſame key; and in order to diſcover this key, he informs us, that the following notes have been obſerved in different birds, A, B flat, C, D, F, and G; and therefore E only is wanting to complete the ſcale: now theſe intervals, he ſays, can only be found in the key of F with a ſharp third, or that of G with a flat third; and he ſuppoſes it to be the latter, becauſe, admitting that the firſt muſical notes were learned from birds, thoſe of the cuckoo, which have been moſt attended to, form a flat third, and moſt of our compoſitions are in a flat third, where muſic is ſimple, and conſiſts merely of melody. As a farther evidence that birds ſing always in the ſame key, it has been found by attending to a nightingale, as well as a robin which was educated under him, that the notes reducible to our intervals of the octave were always preciſely the ſame. Song.

Moſt people, who have not attended to the notes of birds, ſuppoſe, that every ſpecies ſing exactly the ſame notes and paſſages: but this is by no means true; though it is admitted that there is a general reſemblance. Thus the London bird-catchers prefer the ſong of the Kentiſh goldfinches, and Eſſex chaffinches; and ſome of the nightingale-fanciers prefer a Surry bird to thoſe of Middleſex.

Of all ſinging birds, the ſong of the nightingale has been moſt univerſally admired: and its ſuperiority (deduced from a caged bird) conſiſts in the following particulars; its tone is much more mellow than that of any other bird, though at the ſame time, by a proper exertion of its muſical powers, it can be very brilliant. Another point of ſuperiority is its continuance of ſong without a pauſe, which is ſometimes no leſs than 20 ſeconds; and when reſpiration becomes neceſſary, it takes it with as much judgment as an opera-ſinger. The ſky-lark in this particular, as well as in compaſs and variety, is only ſecond to the nightingale. The nightingale alſo ſings (if the expreſſion may be allowed) with ſuperior judgment and taſte. Mr Barrington has obſerved, that his nightingale, which was a very capital bird, began ſoftly like the ancient orators; reſerving its breath to ſwell certain notes, which by theſe means had a moſt aſtoniſhing effect. This writer adds, that the notes of birds, which are annually imported from Aſia, Africa, and America, both ſingly and in concert, are not to be compared to thoſe of European birds.

The following table, formed by Mr Barrington, agreeably to the idea of M. de Piles in eſtimating the merits of painters, is deſigned to exhibit the comparative merit of the Britiſh ſinging birds; in which 20 is ſuppoſed to be the point of abſolute perfection.

Nightingale

Song ‖ Sophi.

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	Mellowneſs of tone.	Sprightly notes.	Plaintive notes.	Compaſs.	Execution.
Nightingale	19	14	19	19	19
Sky-lark	4	19	4	18	18
Wood-lark	18	4	17	12	8
Tit-lark	12	12	12	12	12
Linnet	12	16	12	16	18
Goldfinch	4	19	4	12	12
Chaffinch	4	12	4	8	8
Greenfinch	4	4	4	4	6
Hedge-ſparrow	6	0	6	4	4
Aberdavine or fiſkin	2	4	0	4	4
Red-poll	0	4	0	4	4
Thruſh	4	4	4	4	4
Blackbird	4	4	0	2	2
Robin	6	16	12	12	12
Wren	0	12	0	4	4
Reed ſparrow	0	4	0	2	2
Black-cap, or Norfolk mock nightingale	14	12	12	14	14

SONNA, a book of Mahometan traditions, which all the orthodox muſſulmen are required to believe.

SONNERATIA, in botany; a genus of plants belonging to the claſs of *icoſandria*, and to the order of *monogynia*. The calyx is cut into ſix ſegments; the petals are ſix; the capſule is multilocular and ſucculent; and the cells contain many ſeeds. The only ſpecies is the *acida*.

SONNET, in poetry, a compoſition contained in 14 verſes, viz. two ſtanzas or meaſures of four verſes each, and two of three, the eight firſt verſes being all in three rhimes.

SONNITES, among the Mahometans, an appellation given to the orthodox muſſulmen or true believers; in oppoſition to the ſeveral heretical ſects, particularly the Shiites or followers of Ali.

SOOJU, or Soy. See Dolichos.

SOONTABURDAR, in the Eaſt Indies; an attendant, who carries a ſilver bludgeon in his hand about two or three feet long, and runs before the palanquin. He is inferior to the Chubdar; the propriety of an Indian newaury requiring two Soontaburdars for every Chubdar in the train. The Chubdar proclaims the approach of viſitors, &c. He generally carries a large ſilver ſtaff about five feet long in his hands: and among the Nabobs he proclaims their praiſes aloud as he runs before their palanquins.

SOOT, a volatile matter ariſing from wood and other fuel along with the ſmoke; or rather, it is the ſmoke itſelf condenſed and gathered to the ſides of the chimney. Tho' once volatile, however, ſoot cannot be again reſolved into vapour; but, if diſtilled by a ſtrong fire, yields a volatile alkali and empyreumatic oil, a conſiderable quantity of fixed matter remaining at the bottom of the diſtilling veſſel. If burnt in an open fire, it flames with a thick ſmoke, whence other ſoot is produced. It is uſed as a material for making ſal ammoniac, and as a manure. See Chemistry, n° 796.; and Agriculture, n° 20.

Soot-Black. See *Colour-Making*.

SOPHI, or Sofi, a title given to the emperor of Perſia; importing as much as wiſe, ſage, or philoſopher. Sophis, Sophiſm.

The title is by ſome ſaid to have taken its riſe from a young ſhepherd named *Sophi*, who attained to the crown of Perſia in 1370; others derive it from the *ſophoi* or ſages anciently called *magi*. Voſſius gives a different account of the word: ſophi in Arabic, he obſerves, ſignifies *wool*; and he adds, that it was applied by the Turks out of deriſion to the kings of Perſia ever ſince Iſhmael's time; becauſe, according to their ſcheme of religion, he is to wear no other covering on his head but an ordinary red woollen ſtuff; whence the Perſians are alſo called *hezelbaſchs*, q. d. *red-heads*. But Bochart aſſures us, that ſophi in the original Perſian language, ſignifies one that is pure in his religion, and who prefers the ſervice of God in all things: and derives it from an order of religious called by the ſame name. The ſophis value themſelves on their illuſtrious extraction. They are deſcended in a right line from Houſſein, ſecond ſon of Ali, Mahomet's couſin, and Fatima, Mahomet's daughter.

Sophis, or *Sofees*, a kind of order of religious among the Mahometans in Perſia, anſwering to what are otherwiſe called *derviſes*, and among the Arabs and Indians *faquirs*. Some will have them called ſophis from a kind of coarſe camblet which they wear called *ſouf*, from the city Souf in Syria, where it is principally manufactured. The more eminent of thoſe ſophis are complimented with the title *ſchiek*, that is, *reverend*, much as in Romiſh countries the religious are called *reverend fathers*. Schiek ſophi, who laid the foundation of the grandeur of the royal houſe of Perſia, was the founder, or rather the reſtorer of this order: Iſhmael, who conquered Perſia, was himſelf a ſophi, and greatly valued himſelf on his being ſo. He choſe all the guards of his perſon from among the religious of this order; and would have all the great lords of his court ſophis. The king of Perſia is ſtill grandmaſter of the order; and the lords continue to enter into it, though it be now fallen under ſome contempt.

SOPHISM, in logic, a ſpecious argument having the appearance of truth, but leading to falſehood. Sophiſms are reduced by Ariſtotle into eight claſſes, an arrangement ſo juſt and comprehenſive, that it is equally proper in preſent as in former times. 1. *Ignoratio elenchi*, in which the ſophiſt ſeems to determine the queſtion, while he only does it in appearance. Thus the queſtion, "Whether exceſs of wine be hurtful?" ſeems to be determined by proving, that wine revives the ſpirits and gives a man courage: but the principal point is here kept out of ſight; for ſtill it may be hurtful to health, to fortune, and reputation. 2. *Petitio principii*, a begging of the queſtion, or taking for granted that which remains to be proved, as if any one ſhould undertake to prove that the ſoul is extended through all the parts of the body, becauſe it reſides in every member. This is affirming the ſame thing in different words. 3. Reaſoning in a circle; as when the Roman Catholics prove the Scriptures to be the word of God by the authority of the church, and the authority of the church from the Scriptures. 4. *Non cauſa pro cauſa*, or the aſſigning of a falſe cauſe to any effect. Thus the ſuppoſed principle, that nature abhors a vacuum, was applied to explain the riſing of water in a pump before Galileo diſcovered that it was owing to the preſſure of the atmo-

Sophiſm || Sophiſtication.

atmoſphere In this way the vulgar aſcribe accidents to divine vengeance, and the hereſies and infidelity of modern times are ſaid to be owing to learning. 5. *Fallacia accidentis*, in which the ſophiſt repreſents what is merely accidental as eſſential to the nature of the ſubject. This is nearly allied to the former, and is committed by the Mahometans and Roman Catholics. The Mahometans forbid wine, becauſe it is ſometimes the occaſion of drunkenneſs and quarrels; and the Roman Catholics prohibit the reading of the Bible, becauſe it has ſometimes promoted hereſies. 6. By deducing an univerſal aſſertion from what is true only in particular circumſtances, and the reverſe; thus ſome men argue, "tranſcribers have committed many errors in copying the Scriptures, therefore they are not to be depended on." 7. By aſſerting any thing in a compound ſenſe which is only true in a divided ſenſe; ſo when the Scriptures aſſure us, that the worſt of ſinners may be ſaved, it does not mean that they ſhall be ſaved while they remain ſinners, but that if they repent they may be ſaved. 8. By an abuſe of the ambiguity of words. Thus Mr Hume reaſons in his Eſſay on Miracles: "Experience is our only guide in reaſoning concerning matters of fact; now we know from experience, that the laws of nature are fixed and invariable. On the other hand, teſtimony is variable and often falſe; therefore ſince our evidence for the reality of miracles reſts ſolely on teſtimony which is variable, and our evidence for the uniformity of the laws of nature is invariable, miracles are not to be believed." The ſophiſtry of this reaſoning depends on the ambiguity of the word *experience*, which in the firſt propoſition ſignifies the maxims which we form from our own obſervation and reflection; in the ſecond it is confounded with teſtimony; for it is by the teſtimony of others, as well as our own obſervation, that we learn whether the laws of nature are variable or invariable. The Eſſay on Miracles may be recommended to thoſe who wiſh to ſee more examples of ſophiſtry; as we believe moſt of the eight ſpecies of ſophiſms which we have mentioned are well illuſtrated by examples in that eſſay.

SOPHIST, an appellation aſſumed in the early periods of Grecian hiſtory by thoſe who devoted their time to the ſtudy of ſcience. This appellation appearing too arrogant to Pythagoras, he declined it, and wiſhed to be called a *philoſopher*; declaring that, though he could not conſider himſelf as a wiſe man, he was indeed a lover of wiſdom. True wiſdom and modeſty are generally united. The example of Pythagoras was followed by every man of eminence; while the name *Sophiſt* was retained only by thoſe who with a pomp of words made a magnificent diſplay of wiſdom upon a very ſlight foundation of knowledge. Thoſe men taught an artificial ſtructure of language, and a falſe method of reaſoning, by which, in argument, the worſe might be made to appear the better reaſon (ſee SOPHISM). In Athens they were long held in high repute, and ſupported, not only by contributions from their pupils, but by a regular ſalary from the ſtate. They were among the bittereſt enemies of the illuſtrious Socrates, becauſe he embraced every opportunity of expoſing to contempt and ridicule their vain pretenſions to ſuperior knowledge, and the pernicious influence of their doctrines upon the taſte and morals of the Athenian youth.

SOPHISTICATION, the mixing of any thing with what is not genuine; a practice too common in the making up of medicines for ſale; as alſo among vintners, diſtillers, and others, who are accuſed of ſophiſticating their wines, ſpirits, oils, &c. by mixing with them cheaper and coarſer materials; and in many caſes the cheat is carried on ſo artfully as to deceive the beſt judges. Sophocles.

SOPHOCLES, the celebrated Greek tragic poet, the ſon of Sophilus an Athenian, was born at Colonn, and educated with great attention. Superior vigour and addreſs in the exerciſes of the paleſtra, and ſkill in muſic, were the great accompliſhments of young men in the ſtates of Greece. In theſe, Sophocles excelled; nor was he leſs diſtinguiſhed by the beauty of his perſon. He was alſo inſtructed in the nobleſt of all ſciences, civil polity and religion: from the firſt of theſe he derived an unſhaken love of his country, which he ſerved in ſome embaſſies, and in high military command with Pericles; from the latter he was impreſſed with a pious reverence for the gods, manifeſted by the inviolable integrity of his life. But his ſtudies were early devoted to the tragic muſe; the ſpirit of Eſchylus lent a fire to his genius, and excited that noble emulation which led him to contend with, and ſometimes to bear away the prize from, his great maſter. He wrote 43 tragedies, of which 7 only have eſcaped the ravages of time: and having teſtified his love of his country by refuſing to leave it, though invited by many kings; and having enjoyed the uninterrupted eſteem and affection of his fellow-citizens, which neither the gallant actions and ſublime genius of Eſchylus, nor the tender ſpirit and philoſophic virtue of Euripides, could ſecure to them, he died in the 91ſt year of his age, about 406 years before Chriſt. The burial-place of his anceſtors was at Decelia, which the Lacedemonians had at that time ſeized and fortified; but Lyſander, the Spartan chief, permitted the Athenians to inter their deceaſed poet; and they paid him all the honours due to his love of his country, integrity of life, and high poetic excellence. Eſchylus had at once ſeized the higheſt poſt of honour in the field of poetry, the true ſublime; to that eminence his claim could not be diſputed. Sophocles had a noble elevation of mind, but tempered with ſo fine a taſte, and ſo chaſtened a judgment, that he never paſſed the bounds of propriety. Under his conduct the tragic muſe appeared with the chaſte dignity of ſome noble matron at a religious ſolemnity; harmony is in her voice, and grace in all her motions. From him the theatre received ſome additional embelliſhments; and the drama the introduction of a third ſpeaker, which made it more active and more intereſting: but his diſtinguiſhed excellence is in the judicious diſpoſition of the fable, and ſo nice a connection and dependence of the parts on each other, that they all agree to make the event not only probable, but even neceſſary. This is peculiarly admirable in his "Œdipus King of Thebes;" and in this important point he is far ſuperior to every other dramatic writer.

The ingratitude of the children of Sophocles is well known. They wiſhed to become immediate maſters of their father's poſſeſſions; and therefore tired of his long life, they accuſed him before the Areopagus of inſanity. The only defence the poet made was to read his tragedy of Œdipus at Colonos, which he had lately finiſhed; and then he aſked his judges, whether the au-

Sophora || Sorbus.

thor of such a performance could be taxed with insanity? The father upon this was acquitted, and the children returned home covered with shame and confusion. The seven tragedies of Sophocles which still remain, together with the Greek Scholia which accompany them, have been translated into Latin by Johnson, and into English by Dr Franklin and Mr Potter.

SOPHORA, in botany: A genus of plants belonging to the class of *decandria*, and to the order of *monogynia*; and in the natural system arranged under the 32d order, *Papilionaceæ*. The calyx is quinquedentate and gibbous above: the corolla is papilionaceous; the wings being of the same length with the vexillum: the seed is contained in a legumen. There are 16 species; the tetraptera, microphylla, flavescens, alopecuroides, tomentosa, occidentalis, capensis, aurea, japonica, genistoides, australis, tinctoria, alba, lupinoides, biflora, and hirsuta.

SOPORIFIC, or SOPORIFEROUS, a medicine that produces sleep. Such are opium, laudanum, the seed of poppies, &c. The word is formed from the Latin *sopor* "sleep." The Greeks in place of it use the word *hypnotic*.

SORBONNE, or SORBON, the house or college of the faculty of theology established in the university of Paris. It was founded in 1252 by St Louis, or rather by Robert de Sorbon his confessor and almoner, first canon of Cambray, and afterwards of the church of Paris; who gave his own name to it, which he himself took from the village of Sorbon or Serbon, near Sens, where he was born. The foundation was laid in 1250; queen Blanche, in the absence of her husband, furnishing him with a house which had formerly been the palace of Julian the apostate, of which some remains are still seen. Afterwards the king gave him all the houses he had in the same place, in exchange for some others. The college has been since magnificently rebuilt by the cardinal de Richelieu. The design of its institution was for the use of poor students in divinity. There are lodgings in it for 36 doctors, who are said to be of the *society of the Sorbonne*; those admitted into it without being doctors, are said to be of the *hospitality of the Sorbonne*. Six regent doctors formerly held lectures every day for an hour and a half each; three in the morning, and three in the afternoon.

SORBONNE, is also used in general for the whole faculty of theology at Paris; as the assemblies of the whole body are held in the house of the Sorbonne; and the bachelors of the other houses of the faculty, as the house of Navarre, &c. come hither to hold their *sorbonnique*, or act for being admitted doctor in divinity.

SORBUS, SERVICE-TREE, in botany; a genus of plants belonging to the class of *icosandria*, and to the order of *trigynia*. The calyx is quinquefid; the petals are five; the berry is below the flower, soft and containing three seeds. There are three species; the aucuparia, domestica, and hebrida.

1. The *aucuparia*, mountain-ash, quicken-tree, quickbeam, or roan-tree, rises with a straight upright stem and regular branching head, twenty or thirty feet high or more, covered with a smooth greyish brown bark; pinnated leaves of eight or ten pair of long, narrow, serrated folioles, and an odd one, smooth on both sides; and large umbellate clusters of white flowers at the sides and ends of the branches, succeeded by clusters of fine red berries, ripe in autumn and winter. There is a variety with yellow striped leaves. This species grows wild in many parts of this island in mountainous places, woods, and hedge-rows, often growing to the size of timber; and is admitted into most ornamental plantations, for the beauty of its growth, foliage, flowers, and fruit; the latter, in particular, being produced in numerous red large bunches all over the tree, exhibit a fine appearance in autumn and winter, till devoured by the birds, especially the blackbird and thrush, which are so allured by this fruit as to flock from all parts and feed on it voraciously.—In the island of Jura the juice of the berries is employed as an acid for punch. It is probable that this tree was in high esteem with the Druids; for it is more abundant than any other tree in the neighbourhood of those Druidical circles of stones, so common in North Britain. It is still believed by some persons, that a branch of this tree can defend them from enchantment or witchcraft. Even the cattle are supposed to be preserved by it from danger. The dairy-maid drives them to the summer pastures with a rod of the roan-tree, and drives them home again with the same. In Strathspey, we are told, a hoop is made of the wood of this tree on the 1st of May, and all the sheep and lambs are made to pass through it.

Sorbus, Sorcery.

2. The *domestica*, or cultivated service-tree, with eatable fruit, grows with an upright stem, branching 30 or 40 feet high or more, having a browniſh bark, and the young shoots in summer covered with a mealy down; pinnated leaves of eight or ten pair of broadish deeply serrated lobes and an odd one, downy underneath, and large umbellate clusters of white flowers at the sides and ends of the branches, succeeded by bunches of large, fleshy, edible red fruit, of various shapes and sizes. This tree is a native of the southern warm parts of Europe, where its fruit is used at table as a desert, and it is cultivated here in many of our gardens, both as a fruit-tree and as an ornament to diversify hardy plantations.

3. The *hebrida*, or mongrel service-tree of Gothland, grows twenty or thirty feet high; it has half-pinnated leaves, very downy underneath; and clusters of white flowers, succeeded by bunches of round reddish berries in autumn.

SORCERY, or MAGIC; the power which some persons were formerly supposed to possess of commanding the devil and the infernal spirits by skill in charms and invocations, and of soothing them by fumigations. Sorcery is therefore to be distinguished from witchcraft; an art which was supposed to be practised, not by commanding evil spirits, but by compact with the devil. As an instance of the power of bad smells over demons or evil spirits, we may mention the flight of the evil spirit mentioned in Tobit into the remote parts of Egypt, produced, it is said, by the smell of the burnt liver of a fish. Lilly informs us, that one Evans having raised a spirit at the request of Lord Bothwell and Sir Kenelm Digby, and forgetting a fumigation, the spirit, vexed at the disappointment, pulled him without the circle, and carried him from his house in the Minories into a field near Battersea Causeway.

King James, in his *Dæmonologia*, has given a very full account of the art of sorcery. "Two principal things (says he) cannot well in that errand be wanted:

Sorcery. holy water (whereby the devill mockes the papiſts), and ſome preſent of a living thing unto him. There are likewiſe certaine daies and houres that they obſerve in this purpoſe. Theſe things being all ready and prepared, circles are made, triangular, quadrangular, round, double, or ſingle, according to the forme of the apparition they crave. When the conjured ſpirit appeares, which will not be while after many circumſtances, long prayers, and much muttering and murmurings of the conjurors, like a papiſt prieſt diſpatching a hunting maſſe—how ſoone, I ſay, he appeares, if they have miſſed one jote of all their rites; or if any of their feete once ſlyd over the circle, through terror of his fearfull apparition, he paies himſelf at that time, in his owne hand, of that due debt which they ought him, and otherwiſe would have delaied longer to have paied him: I mean, he carries them with him, body and ſoule." How the conjurors made triangular or quadrangular circles, his majeſty has not informed us, nor does he ſeem to imagine there was any difficulty in the matter. We are therefore led to ſuppoſe, that he learned his mathematics from the ſame ſyſtem as Dr Sacheverell, who, in one of his ſpeeches or ſermons, made uſe of the following ſimile: "They concur like parallel lines, meeting in one common centre."

Another mode of conſulting ſpirits was by the beryl, by means of a ſpeculator or ſeer; who, to have a complete ſight, ought to be a pure virgin, a youth who had not known woman, or at leaſt a perſon of irreproachable life and purity of manners. The method of ſuch conſultation is this: The conjuror having repeated the neceſſary charms and adjurations, with the litany or invocation peculiar to the ſpirits or angels he wiſhes to call (for every one has his particular form), the ſeer looks into a cryſtal or beryl, wherein he will ſee the anſwer, repreſented either by types or figures; and ſometimes, though very rarely, will hear the angels or ſpirits ſpeak articulately. Their pronunciation is, as Lilly ſays, like the Iriſh, much in the throat. Lilly deſcribes one of theſe beryls or cryſtals. It was, he ſays, as large as an orange, ſet in ſilver, with a croſs at the top, and round about engraved the names of the angels Raphael, Gabriel, and Uriel. A delineation of another is engraved in the frontiſpiece to Aubery's Miſcellanies.

Theſe ſorcerers or magicians do not always employ their art to do miſchief; but, on the contrary, frequently exert it to cure diſeaſes inflicted by witches; to diſcover thieves; recover ſtolen goods; to foretel future events, and the ſtate of abſent friends. On this account they are frequently called *white witches*. See MAGIC, WITCHCRAFT, &c.

Our forefathers were ſtrong believers when they enacted, by ſtatute 33 Hen. VIII. c. 8. all witchcraft and ſorcery to be felony without benefit of clergy; and again, by ſtatute 1 Jac. I. c. 12. that all perſons invoking any evil ſpirit, or conſulting, covenanting with, entertaining, employing, feeding, or rewarding any evil ſpirit; or taking up dead bodies from their graves to be uſed in any witchcraft, ſorcery, charm, or inchantment; or killing or otherwiſe hurting any perſon by ſuch infernal arts; ſhould be guilty of felony without benefit of clergy, and ſuffer death. And if any perſon ſhould attempt by ſorcery to diſcover hidden treaſure, or to reſtore ſtolen goods, or to provoke unlawful love, Sorex. or to hurt any man or beaſt, though the ſame were not effected, he or ſhe ſhould ſuffer impriſonment and pillory for the firſt offence, and death for the ſecond. Theſe acts continued in force till lately, to the terror of all ancient females in the kingdom; and many poor wretches were ſacrificed thereby to the prejudice of their neighbours and their own illuſions, not a few having by ſome means or other confeſſed the fact at the gallows. But all executions for this dubious crime are now at an end; our legiſlature having at length followed the wiſe example of Louis XIV. in France, who thought proper by an edict to reſtrain the tribunals of juſtice from receiving informations of witchcraft. And accordingly it is with us enacted, by ſtatute 9 Geo. II. c. 5. that no proſecution ſhall for the future be carried on againſt any perſon for conjuration, witchcraft, ſorcery, or inchantment: But the miſdemeanor of perſons pretending to uſe witchcraft, tell fortunes, or diſcover ſtolen goods, by ſkill in the occult ſciences, is ſtill deſervedly puniſhed with a year's impriſonment, and ſtanding four times in the pillory.

SOREX, the SHREW, in natural hiſtory; a genus of animals belonging to the claſs of *mammalia*, and order of *feræ*. It has two long fore-teeth in the upper jaw, which are divided into two points; in the lower jaw are two or four fore-teeth, the two middle ones, in the latter caſe, being ſhorter than the others: On each ſide in both jaws are two or more tuſks: The grinders are knobbed. The animals of this genus have in general thick clumſy bodies, and five toes on each of their feet; the head reſembles that of the mole, being thick at the fore-head, much elongated, and ending in a conical ſnout, and having very ſmall eyes; in other circumſtances of general figure they reſemble the murine tribe of quadrupeds. They burrow in the ground, ſome ſpecies living moſtly about the ſides of waters; and moſt of them feeding on worms and inſects. There are 16 ſpecies; of which the moſt remarkable are,

1. The *araneus*, or field ſhrew-mouſe, with ſhort rounded ears; eyes ſmall, and almoſt hid in the fur; noſe long and ſlender, upper part the longeſt; head and upper part of the body of a browniſh red; belly of a dirty white; length from noſe to tail, two inches and a half; tail one and a half. Inhabits Europe: lives in old walls and heaps of ſtones, or holes in the earth; is frequently near hay-ricks, dung-hills, and neceſſary-houſes; lives on corn, inſects, and any filth; is often obſerved rooting in ordure like a hog; from its food, or the places it frequents, has a diſagreeable ſmell; cats will kill, but not eat it: it brings four or five young at a time. The ancients believed it was injurious to cattle; an error now detected. There ſeems to be an annual mortality of theſe animals in Auguſt, numbers being then found dead in the paths.

2. The *fodiens*, or water-ſhrew, has a long ſlender noſe; very minute ears; very ſmall eyes, hid in the fur; colour of the head and upper part of the body black; throat, breaſt and belly, of a light aſh-colour; beneath the tail, a triangular duſky ſpot; much larger than the laſt; length, from noſe to tail, three inches three quarters; tail, two inches. Inhabits Europe: long ſince known in England, but loſt till May 1768, when it was diſcovered in the fens near Reveſley Abbey,

Sorites ‖ Sorrel.

bey, Lincolnſhire; burrows in the banks near the water; is called by the fenmen the *blind-mouſe*.

3. The *minutus*, or minute ſhrew, has a head near as big as the body: very ſlender noſe; broad ſhort naked ears; whiſkers reaching to the eyes; eyes ſmall, and capable of being drawn in; hair very fine and ſhining; grey above, white beneath; no tail; the leaſt of quadrupeds, according to Linnæus. Inhabits Siberia; lives in a neſt made of lichens, in ſome moiſt place beneath the roots of trees; feeds on ſeeds, digs, runs ſwiftly, and has the voice of a bat.

4. The *tucan*, or Mexican ſhrew, has a ſharp noſe; ſmall round ears; without ſight; two long fore-teeth above and below; thick, fat, and fleſhy body; ſhort legs, ſo that the belly almoſt touches the ground; long crooked claws; tawny hair; ſhort tail; length, from noſe to tail, nine inches. Inhabits Mexico; burrows, and makes ſuch a number of cavities, that travellers can ſcarce tread with ſafety; if it gets out of its hole, does not know how to return, but begins to dig another; grows very fat, and is eatable; feeds on roots, kidney-beans, and other ſeeds. M. de Buffon thinks it a mole; but it ſeems more properly to belong to the genus of ſorex.

SORITES, in logic, a ſpecies of reaſoning in which a great number of propoſitions are ſo linked together, that the predicate of the one becomes continually the ſubject of the next following, till at laſt a concluſion is formed by bringing together the ſubject of the firſt propoſition and the predicate of the laſt. Such was that merry argument of Themiſtocles, to prove that his little ſon under ten years old governed the whole world. Thus: *My ſon governs his mother; his mother me; I the Athenians; the Athenians the Greeks; Greece commands Europe; Europe the whole world: therefore my ſon commands the whole world.* See LOGIC, n° 96, 97.

SORNING, in Scots law. See LAW, N° clxxxvi. 30.

SORREL, in botany, a ſpecies of the RUMEX, which grows in paſtures and meadows, and is well known. The natives of Lapland boil large quantities of the leaves in water, and mix the juice when cold with the milk of their rein-deers which they eſteem an agreeable and wholeſome food. The Dutch are ſaid to cultivate this plant for its uſefulneſs in the dyeing of woollen cloths black; and we know that by means of the common broad-leaved ſorrel an excellent black colour is, in many places of Scotland, given to woollen ſtuffs without the aid of copperas. As this mode of dyeing does not in the ſmalleſt degree injure the texture of the cloth, which continues to the laſt ſoft and ſilky, without that hardneſs to the touch which it acquires when dyed black by means of copperas, our readers will probably thank us for the following receipt, with which we have been favoured by a learned phyſician:

Let the ſtuff to be dyed be well waſhed with ſoap and water, and afterwards completely dried. Then of the common broad-leaved ſorrel boil as much as ſhall make an acid decoction of ſufficient quantity to let the ſtuff to be dyed lie in it open and eaſy to be ſtirred. The greater quantity of ſorrel that is uſed, the better will the colour be; and therefore if the pot or cauldron will not hold enough at once, when part has been ſufficiently boiled, it muſt be taken out and wrung, and a freſh quantity be boiled in the ſame juice or decoction. When the liquor is made ſufficiently acid, ſtrain it from the ſorrel through a ſieve, put the cloth or yarn into it, and let it boil for two hours, ſtirring it frequently. If ſtockings be among the ſtuff to be dyed, it will be expedient, after they have been an hour in the boiling liquor, to turn them inſide out, and at the end of the ſecond hour let the whole be poured into a tub or any other veſſel. The pot or cauldron muſt then be waſhed, and water put into it, with half a pound of logwood chips for every pound of dry yarn or cloth. The logwood and water ſhould boil ſlowly for four hours; and then the cloth or yarn being wrung from the ſour liquor, and put into the logwood decoction, the whole muſt be ſuffered to boil ſlowly for four hours, ſtockings, if there be any, being turned inſide out at the end of two hours. Of this laſt decoction there muſt as of the former be enough to let the cloth lie open and eaſy to be ſtirred while boiling. At the end of the four hours the cloth muſt be taken out, and among the boiling liquor, firſt removed from the fire, muſt be poured a Scotch pint or Engliſh gallon of ſtale urine for every pound of dry cloth or other ſtuff to be dyed. When this compound liquor has been ſtirred and become cold, the cloth muſt be put into it and ſuffered to remain well covered for 12 hours, and then dried in the ſhade; after which, to diveſt it of ſmell or any other impurity, it may be waſhed in cold water, and dried for uſe.

*Wood-*SORREL, in botany. See OXALIS.

Sorrel-Colour, in the manege, is a reddiſh colour, generally thought to be a ſign of a good horſe.

SORRENTO, a ſea-port town of the kingdom of Naples, with an archbiſhop's ſee. It is ſeated in a peninſula, on the bay of Naples, at the foot of a mountain of the ſame name, 17 miles ſouth-eaſt of Naples. It is the birth-place of Torquato Taſſo. E. Long. 14. 24. N. Lat. 40. 36.

SORTILEGE (*Sortilegium*), a ſpecies of divination performed by means of *ſortes* or lots.

The *ſortes Preneſtinæ*, famous in antiquity, conſiſted in putting a number of letters, or even whole words, into an urn; and then, after ſhaking them together, they were thrown on the ground; and whatever ſentences could be made out from them, conſtituted the anſwer of the oracle. To this method of divination ſucceeded that which has been called the *ſortes Homerianæ* and *ſortes Virgilianæ*, a mode of inquiring into futurity, which undoubtedly took its riſe from a general cuſtom of the oracular prieſts of delivering their anſwers in verſe; it ſubſiſted a long time among the Greeks and Romans; and being from them adopted by the Chriſtians, it was not till after a long ſucceſſion of centuries that it became exploded. Among the Romans it conſiſted in opening ſome celebrated poet at random, and among the Chriſtians the Scriptures, and drawing, from the firſt paſſage which preſented itſelf to the eye, a prognoſtic of what would befal one's ſelf or others, or direction for conduct when under any exigency. There is good evidence that this was none of the vulgar errors; the greateſt perſons, philoſophers of the beſt repute, admitted this ſuperſtition. Socrates, when in priſon, hearing this line of Homer,

Within three days I Phthia's ſhore ſhall ſee,

Sorrel ‖ Sortilege.

immediately

Sortilege. immediately ſaid, within three days I ſhall be out of the world; gathering it from the double meaning of the word *Phthia*, which in Greek is both the name of a country and ſignifies corruption or death. This prediction, addreſſed to Æſchinus, was not eaſily forgotten, as it was verified.

When this ſuperſtition paſſed from Paganiſm into Chriſtianity, the Chriſtians had two methods of conſulting the divine will from the Scriptures; the one, caſually, to open the divine writings, and take their direction, as above-mentioned; the other, to go to church with a purpoſe of receiving, as a declaration of the will of heaven, the words of the Scripture, which were ſinging at the inſtant of one's entrance.

This unwarrantable practice of inquiring into futurity prevailed very generally in England till the beginning of the preſent century; and ſometimes the books of Scripture, and ſometimes the poems of Virgil, were conſulted for oracular reſponſes. One remarkable inſtance is that of King Charles I. who being at Oxford during the civil wars, went one day to ſee the public library, where he was ſhowed, among other books, a Virgil nobly printed and exquiſitely bound. The lord Falkland, to divert the king, would have his majeſty make a trial of his fortune by the *Sortes Virgilianæ*. Whereupon the king opening the book, the period which happened to come up was this:

At bello audacis populi vexatus, et armis,
Finibus extorris, complexu avulſus Iuli,
Auxilium imploret; videatque indigna ſuorum
Funera; nec, cum ſe ſub leges pacis iniquæ
Tradiderat, regno aut optata luce fruatur;
Sed cadat ante diem, mediaque inhumatus arena.
Æneid. lib. iv.

Yet let a race, untamed and haughty foes,
His peaceful entrance with dire arms oppoſe;
Oppreſſed with numbers in the unequal field,
His men diſcouraged, and himſelf expelled,
Let men for ſuccour ſue from place to place,
Torn from his ſubjects, and his ſon's embrace:
Firſt let him ſee his friends in battle ſlain,
And their untimely fate lament in vain;
And when at length the cruel war ſhall ceaſe,
On hard conditions may he buy his peace.
Nor let him then enjoy ſupreme command,
But fall untimely by ſome hoſtile hand,
And lie unburied on the barren ſand.

Lord Falkland obſerving that the king was concerned at this accident, would likewiſe try his own fortune in the ſame manner, hoping he might fall upon ſome paſſage that would have no relation to his caſe, and thereby divert the king's thoughts from any impreſſion which the other might have upon him; but the place he ſtumbled upon was as much ſuited to his deſtiny as the other had been to the king's; being the lamentation of Evander for the untimely death of his ſon Pallas*: for this lord's eldeſt ſon, a young man of an amiable character, had been ſlain in the firſt battle of Newbury.

* Æneid. lib. xi.

We have ourſelves known ſeveral whoſe devotion has not always been regulated by judgment purſue this method of divination; and have generally obſerved, that the conſequence has been deſpair or preſumption. To ſuch we beg leave to recommend one paſſage in Scripture which will never diſappoint them: *Thou ſhalt not tempt the Lord thy God.*

Soteria || Sound.

SOTERIA, in antiquity, ſacrifices offered to the gods for delivering a perſon from danger; as alſo poetical pieces compoſed for the ſame purpoſe.

SOUBISE, a town of France, in the department of Lower Charente, and late territory of Saintonge. It is ſeated on the river Charente, 22 miles ſouth of Rochelle, in W. Long. 1. 2. N. Lat. 45. 57.

SOUGH, among miners, denotes a paſſage dug under ground, to convey off waters from mines. See MINE.

SOVEREIGN, in matters of government, is applied to the ſupreme magiſtrate or magiſtrates of an independent government or ſtate; becauſe their authority is only bounded by the laws of God and the laws of the ſtate: ſuch are kings, princes, &c. See PREROGATIVE, &c.

SOVEREIGN Power, or *Sovereignty*, is the power of making laws; for wherever that power reſides, all others muſt conform to it, and be directed by it, whatever appearance the outward form and adminiſtration of the government may put on. For it is at any time in the option of the legiſlature to alter that form and adminiſtration by a new edict or rule, and to put the execution of the laws into whatever hands it pleaſes: and all the other powers of the ſtate muſt obey the legiſlative power in the execution of their ſeveral functions, or elſe the conſtitution is at an end. In our conſtitution the law aſcribes to the king the attribute of ſovereignty: but that is to be underſtood in a qualified ſenſe, *i. e.* as ſupreme magiſtrate, not as ſole legiſlator; as the legiſlative power is veſted in the king, lords, and commons, not in any of the three eſtates alone. *Blackſt. Comment.*

SOU. See SOL.

SOUL, the principle of perception, memory, intelligence, and volition, in man; which, ſince the earlieſt era of philoſophy, has furniſhed queſtions of difficult inveſtigation, and materials of keen and important controverſy (ſee METAPHYSICS, Part III. chap. ii. iii. iv. v.; and RESURRECTION, n° 42—48.) In the fourth volume of the Memoirs of the Literary and Philoſophical Society of Mancheſter, the reader will find a very valuable paper by Dr Farrier, proving, by evidence apparently complete, that every part of the brain has been injured without affecting the act of thought. An abridgment of that memoir would weaken its reaſoning; which, built on matters of fact and experience, appears to us to have ſhaken the modern theory of the Materialiſts from its very foundation.

SOUL of Brutes. See BRUTES.

SOUND, in phyſics, is a term of which it would be prepoſterous to offer any definition, as it may almoſt be ſaid to expreſs a ſimple idea: But when we conſider it as a SENSATION, and ſtill more when we conſider it as a PERCEPTION, it may not be improper to give a deſcription of it; becauſe this muſt involve certain relations of external things, and certain trains of events in the material world, which make it a proper object of philoſophical diſcuſſion. Sound is that primary information which we get of external things by means of the ſenſe of hearing. This, however, does not explain it: for were we in like manner to deſcribe our ſenſe of hearing, we ſhould find ourſelves obliged to ſay, that it is the faculty by which we perceive ſound. Languages

Sound. are not the invention of philoſophers; and we muſt not expect preciſion, even in the ſimpleſt caſes. Our methods of expreſſing the information given us by our different ſenſes are not ſimilar, as a philoſopher, cautiouſly contriving language, would make them. We have no word to expreſs the primary or generic object of our ſenſe of ſeeing; for we believe, that even the vulgar conſider light as the medium, but not the object. This is certainly the caſe (how juſtly we do not ſay) with the philoſopher. On the other hand, the words ſmell, ſound, and perhaps taſte, are conceived by moſt perſons as expreſſing the immediate objects of the ſenſes of ſmelling, hearing, and taſting. Smell and ſound are haſtily conceived as ſeparate exiſtences, and as mediums of information and of intercourſe with the odoriferous and ſounding bodies; and it is only the very cautious philoſopher who diſtinguiſhes between the ſmell which he feels and the perfume which fills the room. Thoſe of the ancients, therefore, who taught that ſounds were beings wafted through the air, and felt by our ears, ſhould not, even at this day, be conſidered as aukward obſervers of nature. It has required the long, patient, and ſagacious conſideration of the moſt penetrating geniuſes, from Zeno the ſtoic to Sir Iſaac Newton, to diſcover that what we call ſound, the *immediate* external object of the ſenſe of hearing, is nothing but a particular agitation of the parts of ſurrounding bodies, acting by mechanical impulſe on our organs; and that it is not any ſeparate being, nor even a ſpecific quality inherent in any particular thing, by which it can affect the organ, as we ſuppoſe with reſpect to a perfume, but merely a mode of exiſtence competent to every atom of matter. And thus the deſcription which we propoſed to give of ſound muſt be a deſcription of that ſtate of external contiguous matter which is the *cauſe* of ſound. It is not therefore prefatory to any theory or ſet of doctrines on this ſubject; but, on the contrary, is the ſum or reſult of them all.

To diſcover this ſtate of external body by which, without any farther intermedium of ſubſtance or of operation, it affects our ſenſitive faculties, muſt be conſidered as a great ſtep in ſcience. It will ſhow us at leaſt one way by which mind and body may be connected. It is ſuppoſed that we have attained this knowledge with reſpect to ſound. Our ſucceſs, therefore, is a very pleaſing gratification to the philoſophic mind. It is ſtill more important in another view: it has encouraged us to make ſimilar attempts in other caſes, and has ſupplied us with a fact to which an ingenious mind can eaſily fancy ſomething analogous in many abſtruſe operations of nature, and thus it enables us to give ſome ſort of explanation of them. Accordingly this uſe has been moſt liberally made of the mechanical theory of ſound; and there is now ſcarcely any phenomenon, either of matter or mind, that has not been explained in a manner ſomewhat ſimilar. But we are ſorry to ſay that theſe explanations have done no credit to philoſophy. They are, for the moſt part, ſtrongly marked with that precipitate and ſelf-conceited impatience which has always characteriſed the inveſtigations conducted ſolely by ingenious fancy. The conſequences of this procedure have been no leſs fatal to the progreſs of true knowledge in modern times than in the ſchools of ancient Greece; and the ethereal philoſophers of this age, like the followers of Ariſtotle of old, have filled ponderous volumes with nonſenſe and error. It is ſtrange, however, that this ſhould be the effect of a great and a ſucceſsful ſtep in philoſophy: But the fault is in the philoſophers, not in the ſcience. Nothing can be more certain than the account which Newton has given of the propagation of a certain claſs of undulations in an elaſtic fluid. But this procedure of nature cannot be ſeen with diſtinctneſs and preciſion by any but well-informed mathematicians. They alone can reſt with unſhaken confidence on the concluſions legitimately deduced from the Newtonian theorems; and even they can inſure ſucceſs only by treading with the moſt ſcrupulous caution the ſteps of this patient philoſopher. But few have done this; and we may venture to ſay, that not one in ten of thoſe who employ the Newtonian doctrines of elaſtic undulations for the explanation of other phenomena have taken the trouble, or indeed were able, to go through the ſteps of the fundamental propoſition (Prin. II. 50, &c.) But the *general* reſults are ſo plain, and admit of ſuch impreſſive illuſtration, that they draw the aſſent of the moſt careleſs reader; and all imagine that they underſtand the explanation, and perceive the whole procedure of nature. Emboldened therefore by this ſucceſsful ſtep in philoſophy, they, without heſitation, *fancy* ſimilar intermediums in other caſes; and as air has been found to be a vehicle for ſound, they have ſuppoſed that ſomething which they call ether, ſomehow reſembling air, is the vehicle of viſion. Others have proceeded farther, and have held that ether, or another ſomething like air, is the vehicle of ſenſation in general, from the organ to the brain: nay, we have got a great volume called A Theory of Man, where all our ſenſations, emotions, affections, thoughts, and purpoſes or volitions, are ſaid to be ſo many vibrations of another ſomething equally unſeen, gratuitous, and incompetent; and, to crown all, this exalted doctrine, when logically proſecuted, muſt terminate in the diſcovery of thoſe vibrations which pervade all others, and which conſtitute what we have been accuſtomed to venerate by the name Deity. Such *muſt* be the termination of this philoſophy; and a truly philoſophical diſſertation on the attributes of the Divine Being *can be nothing elſe* than an accurate deſcription of theſe vibrations! Sound.

This is not a needleſs and declamatory rhapſody. If the explanation of ſound can be legitimately tranſferred to thoſe other claſſes of phenomena, theſe are certain reſults; and if ſo, all the diſcoveries made by Newton are but the glimmerings of the morning, when compared with this meridian ſplendor. But if, on the other hand, ſound logic forbids us to make this tranſference of explanation, we muſt continue to believe, for a little while longer, that mind is ſomething different from vibrating matter, and that no kind of oſcillations will conſtitute infinite wiſdom.

It is of immenſe importance therefore to underſtand thoroughly this doctrine of ſound, that we may ſee clearly and preciſely in what it conſiſts, what are the phenomena of ſound that are fully explained, what are the data and the aſſumptions on which the explanations proceed, and what is the *preciſe mechanical fact* in which it terminates. For this, or a fact perfectly ſimilar, muſt terminate every explanation which we derive from this by analogy, however perfect the analogy may be. This *previous* knowledge muſt be completely poſſeſſed by eve-

Sound. ry perſon who pretends to explain other phenomena in a ſimilar manner. Then, and not till then, he is able to ſay what claſſes of phenomena will admit of the explanation: and, when all this is done, his explanation is ſtill an *hypotheſis*, till he is able to prove, from other indiſputable ſources, the exiſtence and agency of the ſame thing analogous to the elaſtic fluid, from which all is borrowed. Sound.

Such conſiderations would juſtify us for conſidering with great attention the nature of ſound. But a work like this will not give room for a full diſcuſſion; and we muſt refer our readers to the writers who treat it more at large. Much curious information may be got from the pains-taking authors of the laſt century; ſuch as Lord Bacon; Kircher; Merſennus; Caſſerius in his great work *De Voce et Auditu*; Perrault in his *Diſſertation du Bruit*; Muſſenbroek in his great Syſtem of Natural Philoſophy, in 3 vols 4to; and in his *Eſſais de Phyſique*; and the writings of the celebrated phyſiologiſts of the preſent age. We alſo refer to what has been ſaid by us in the article ACOUSTICS.

At preſent therefore we muſt content ourſelves with giving a ſhort hiſtory of the ſpeculations of philoſophers on this ſubject, tracing out the ſteps by which we have arrived at the knowledge which we have of it. We apprehend this to be of great importance; becauſe it ſhows us what kind of evidence we have for its truth, and the paths which we muſt ſhun if we wiſh to proceed farther: and we truſt that the progreſs which we have made will appear to be ſo real, and the object to be attained ſo alluring to a truly philoſophical mind, that men of genius will be incited to exert their utmoſt efforts to paſs the preſent boundaries of our real progreſs.

In the infancy of philoſophy, ſound was held to be a ſeparate exiſtence, ſomething which would be, although no hearing animal exiſted. This was conceived as wafted through the air to our organ of hearing, which it was ſuppoſed to affect in a manner reſembling that in which our noſtrils are affected when they give us the ſenſation of ſmell. It was one of the Platonic SPECIES, fitted for exciting the intellectual ſpecies, which is the immediate object of the ſoul's contemplation.

Yet, even in thoſe early years of ſcience, there were ſome, and, in particular, the celebrated founder of the ſtoic ſchool, who held that ſound, that is, the cauſe of ſound, was only the particular motion of external groſs matter, propagated to the ear, and there producing that agitation of the organ by which the ſoul is immediately affected with the ſenſation of ſound. Zeno, as quoted by Diogenes Laertius*, ſays, "Hearing is produced by the air which intervenes between the thing ſounding and the ear. The air is agitated in a ſpherical form, and moves off in waves, and falls on the ear, in the ſame manner as the water in a ciſtern undulates in circles when a ſtone has been thrown into it." The ancients were not remarkable for preciſion, either of conception or argument in their diſcuſſions, and they were contented with a general and vague view of things. Some followed the Platonic notions, and many the opinion of Zeno, but without any farther attempts to give a diſtinct conception of the explanation, or to compare it with experiment.

* B. vii. § 158.

But in later times, during the ardent reſearches in the laſt century into the phenomena of nature, this became an intereſting ſubject of inquiry. The invention of the air-pump gave the firſt opportunity of deciding by experiment whether the elaſtic undulations of air were the cauſes of ſound: and the trial fully eſtabliſhed this point; for a bell rung *in vacuo* gave no ſound, and one rung in condenſed air gave a very loud one. It was therefore received as a doctrine in general phyſics that air was the vehicle of ſound.

The celebrated Galileo, the parent of mathematical philoſophy, diſcovered the nature of that connection between the lengths of muſical cords and the notes which they produced, which had been obſerved by Pythagoras, or learned by him in his travels in the eaſt, and which he made the foundation of a refined and beautiful ſcience, the theory of muſic. Galileo ſhowed, that the real connection ſubſiſted between the tones and the vibrations of theſe cords, and that their different degrees of acuteneſs correſponded to the different frequency of their vibrations. The very elementary and familiar demonſtration which he gave of this connection did not ſatisfy the curious mathematicians of that inquiſitive age, and the mechanical theory of muſical cords was proſecuted to a great degree of refinement. In the courſe of this inveſtigation, it appeared that the cord vibrated in a manner preciſely ſimilar to a pendulum vibrating in a cycloid. It muſt therefore agitate the air contiguous to it in the ſame manner; and thus there is a particular kind of agitation which the air *can* receive and maintain, which is very intereſting.

Sir Iſaac Newton took up this queſtion as worthy of his notice; and endeavoured to aſcertain with mathematical preciſion the mechaniſm of this particular claſs of undulations, and gave us the fundamental theorems concerning the undulations of elaſtic fluids, which make the 47, &c. propoſitions of Book II. of his Principles of Natural Philoſophy. They have been (perhaps haſtily) conſidered as giving the fundamental doctrines concerning the propagation of ſound. They are therefore given in this work in the article ACOUSTICS; and a variety of facts are narrated in the article PNEUMATICS, to ſhow that ſuch undulations *actually obtain* in the air of our atmoſphere, and are accompanied by a ſet of phenomena of ſound which preciſely tally or correſpond to all the mechanical circumſtances of theſe undulations. In the mean time, the anatomiſts and phyſiologiſts were buſily employed in examining the ſtructure of our organs of hearing. Impreſſed with the validity of this doctrine of aerial undulations being the cauſes of ſound, their reſearches were always directed with a view to diſcover thoſe circumſtances in the ſtructure of the ear which rendered it an organ ſuſceptible of agitations from this cauſe; and they diſcovered many which appeared as contrivances for making it a drum, on which the aerial undulations from without muſt make very forcible impulſes, ſo as to produce very ſonorous undulations in the air contained in it. Theſe therefore they conſidered as the *immediate* objects of ſenſation, or the immediate cauſes of ſound.

But ſome anatomiſts ſaw that this would not be a full account of the matter: for after a drum is agitated, it has done all that it can do; it has produced a noiſe. But a farther proceſs goes on in our ear: There is behind the membrane, which is the head of this drum a curious mechaniſm, which communicates the agitations of

Sound. of the membrane (the only thing acted on by the undulating air) to another chamber of moſt ſingular conſtruction, where the auditory nerve is greatly expanded. They conceive, therefore, that the organ called the *drum* does not act as a drum, but in ſome other way. Indeed it ſeems bad logic to ſuppoſe that it acts as a drum merely by producing a noiſe. This is in no reſpect different from the noiſe produced out of the ear; and if it is to be heard as a noiſe, we muſt have another ear by which it may be heard, and this ear muſt be another *ſuch* drum; and this muſt have another, and ſo on for ever. It is like the inaccurate notion that viſion is the contemplation of the picture on the retina. Theſe anatomiſts attended therefore to the ſtructure. Here they obſerved a prodigious unfolding of the auditory nerve of the ear, which is curiouſly diſtributed through every part of this cavity, lining its ſides, hung acroſs it like a curtain, and ſending off fibres in every direction, ſo as to leave hardly a point of it unoccupied. They thought the machinery contained in the drum peculiarly fitted for producing undulations of the air contained in this labyrinth, and that by theſe agitations of the air the contiguous fibres of the auditory nerve are impelled, and that thus we get the ſenſation of ſound.

The cavity intervening between the external air and this inner chamber appeared to theſe anatomiſts to have no other uſe than to allow a very free motion to the *ſtapes* or little piſton that is employed to agitate the air in the labyrinth. This piſton condenſes on a very ſmall ſurface the impulſe which it receives from a much larger ſurface, ſtrained by the malleus on the entry of the tympanum, on purpoſe to receive the gentle agitations of the external air in the outer canal. This membranous ſurface could not be agitated, unleſs completely detached from every thing round it; therefore all animals which have this mechaniſm have it in a cavity containing only air. But they held, that nature had even taken precautions to prevent this cavity from acting as a drum, by making it of ſuch an irregular rambling form; for it is by no means a cavity of a ſymmetrical ſhape, like a veſſel, but rather reſembles the rambling holes and blebs which are often ſeen in a piece of bread, ſcattered through the ſubſtance of the cranium, and communicating with each other by ſmall paſſages. The whole of theſe cavernulæ are lined with a ſoftiſh membrane, which ſtill farther unfits this cavity for producing ſound. This reaſoning is ſpecious, but not very concluſive. We might even aſſert, that this anfractuous form, with narrow paſſages, is well fitted for producing noiſe. If we place the ear cloſe to the ſmall hole in the ſide of a military drum, we ſhall hear the ſmalleſt tap of the drumſtick like a violent blow. The lining of the cavernulæ is nervous, and may therefore be ſtrongly affected in the numerous narrow paſſages between the cells.

While theſe ſpeculations were going on with reſpect to the ear of the breathing animals, obſervations were occaſionally made on other animals, ſuch as reptiles, ſerpents, and fiſhes, which give undoubted indications of hearing; and many very familiar facts were obſerved or recollected, where ſounds are communicated through or by means of ſolid bodies, or by water: therefore, without inquiring how or by what kind of mechaniſm it is brought about, it became a very general belief among phyſiologiſts, that all fiſhes, and perhaps all animals hear, and that water in particular is a vehicle of ſound. Sound. In 1767 or 1768 the writer of this article, at the ſuggeſtion of the late profeſſor of aſtronomy in the univerſity of Glaſgow, made an experiment in a lake in that neighbourhood, by ſtriking a large hand-bell under water, and heard it very diſtinctly and ſtrongly when his head was plunged in the water at the diſtance of more than 1200 feet. Many experiments are mentioned by Kircher and others on the communication of ſound through ſolid bodies, ſuch as maſts, yards, and other long beams of dry fir, with ſimilar reſults. Dr Monro has publiſhed a particular account of very curious experiments on the propagation of ſound through water in his Diſſertation on the Phyſiology of Fiſhes; ſo that it now appears that air is by no means the only vehicle of ſound.

In 1760 Cotunni publiſhed his important diſcovery, that the labyrinth or inmoſt cavity of the ear in animals is completely filled with water. This, after ſome conteſt, has been completely demonſtrated (ſee in particular Meckel Junior *de Labyrinthi Auris Contentis*, Argentor, 1777), and it ſeems now to be admitted by all.

This being the caſe, our notions of the immediate cauſe of ſound muſt undergo a great revolution, and a new reſearch muſt be made into the way in which the nerve is affected: for it is not enough that we ſubſtitute the undulations of water for thoſe of air in the labyrinth. The well informed mechanician will ſee at once, that the vivacity of the agitations of the nerve will be greatly increaſed by this ſubſtitution; for if water be perfectly elaſtic through the whole extent of the undulatory agitation which it receives, its effect will be greater in proportion to its ſpecific gravity: and this is confirmed by an experiment very eaſily made. Immerſe a table-bell in water contained in a large thin glaſs veſſel. Strike it with a hammer. The ſound will be heard as if the bell had been immediately ſtruck on the ſides of the veſſel. The filling of the labyrinth of the ear with water is therefore an additional mark of the wiſdom of the Great Artiſt. But this is not enough for informing us concerning the ultimate mechanical event in the proceſs of hearing. The manner in which the nerve is expoſed to theſe undulations muſt be totally different from what was formerly imagined. The filaments and membranes, which have been deſcribed by former anatomiſts, muſt have been found by them in a ſtate quite unlike to their ſituation and condition in the living animal. Accordingly the moſt eminent anatomiſts of Europe ſeem at preſent in great uncertainty as to the ſtate of the nerve, and are keenly occupied in obſervations to this purpoſe. The deſcriptions given by Monro, Scarpa, Camper, Comparetti, and others, are full of moſt curious diſcoveries, which make almoſt a total change in our notions of this ſubject, and will, we hope, be productive of moſt valuable information.

Scarpa has diſcovered that the ſolid cavity called the *labyrinth* contains a threefold expanſion of the auditory nerve. One part of it, the cochlea, contains it in a fibrillous ſtate, ramified in a moſt ſymmetrical manner through the whole of the *zona mollis* of the *lamina ſpiralis*, where it anaſtomoſes with another production of it diffuſed over the general lining of that cavity. Another department of the nerve, alſo in a fibrous ſtate, is ſpread over the external ſurface of a membranaceous bag,

Sound. bag, which nearly fills that part of the veſtibule into which the ſemicircular canals open, and alſo that orifice which receives the impreſſions of the ſtapes. This bag ſends off tubular membranaceous ducts, which, in like manner, nearly fill theſe ſemicircular canals. A third department of the nerve is ſpread over the external ſurface of another membranaceous bag, which lies between the one juſt now mentioned and the cochlea, but having no communication with either, almoſt completely filling the remainder of the veſtibule. Thus the veſtibule and canals ſeem only a caſe for protecting this ſenſitive membranaceous veſſel, which is almoſt, but not altogether, in contact with the oſſeous caſe, being ſeparated by a delicate and almoſt fluid cellular ſubſtance. The fibrillous expanſion of the nerve is not indiſcriminately diffuſed over the ſurface of theſe ſacculi, but evidently directed to certain foci, where the fibres are conſtipated. And this is the laſt appearance of the fibrous ſtate of the nerve; for when the inſide of theſe ſacculi is inſpected, no fibres appear, but a pulp (judged to be nervous from its ſimilarity to other pulpy productions of the brain) adhering to the membranaceous coat, and not ſeparable from it by gently waſhing it. It is more abundant, that is, of greater thickneſs, oppoſite to the external fibrous foci. No organical ſtructure could be diſcovered in this pulp, but it probably is organiſed; for, beſides this adhering pulp, the water in the ſacculi was obſerved to be clammy or mucous; ſo that in all probability the vaſcular or fibrous ſtate of the nerve is ſucceeded by an uninterrupted production (perhaps columnar like baſalt, though not cohering); and this at laſt ends in ſimple diſſemination, ſymmetrical however, where water and nerve are alternate in every direction.

To theſe obſervations of Scarpa, Comparetti adds the curious circumſtances of another and regular tympanum in the foramen rotundum, the cylindric cavity of which is incloſed at both ends by a fine membrane. The membrane which ſeparates it from the cochlea appears to be in a ſtate of variable tenſion, being drawn up to an umbo by a cartilaginous ſpeck in its middle, which he thinks adheres to the lamina ſpiralis, and thus ſerves to ſtrain the drumhead, as the malleus ſtrains the great membrane known to all.

Theſe are moſt important obſervations, and muſt greatly excite the curioſity of a truly philoſophical mind, and deſerve the moſt careful inquiry into their juſtneſs. If theſe are accurate deſcriptions of the organ, they ſeem to conduct us farther into the ſecrets of nature than any thing yet known.

We think that they promiſe to give us the greateſt ſtep yet made in phyſiology, viz. to ſhow us the laſt mechanical fact which occurs in the long train interpoſed between the external body and the incitement of our ſenſitive ſyſtem. But there is, as yet, great and eſſential differences in the deſcription given by thoſe celebrated naturaliſts. It cannot be otherwiſe. The containing labyrinth can be laid open to our view in no other way than by deſtroying it; and its moſt delicate contents are the firſt ſufferers in the ſearch. They are found in very different ſituations and conditions by different anatomiſts, according to their addreſs or their good fortune. Add to this, that the natural varieties are very conſiderable. Faithful deſcriptions muſt therefore give very different notions of the ultimate action and reaction between the unorganiſed matter in the labyrinth and the ultimate expanſion of the auditory nerve. Sound.

We muſt therefore wait with patience. Since this Work of ours was begun, the progreſs which has been made in many parts of natural ſcience has been great and wonderful; and perhaps before it be completed, we may be furniſhed with ſuch a collection of facts reſpecting the ſtructure and the contents of the organ of hearing, as might enable us to give a juſter theory of ſound than is yet to be found in the writings of philoſophers. There ſeems to be no abatement of ardour in the reſearches of the phyſiologiſts; and they will not remain long ignorant of the truth or miſtake in the accounts given by Scarpa and Comparetti. Should the reſult of their inquiries be what we expect, we ſhould be glad of a proper opportunity of laying it before our readers, together with ſome diſquiſition on the nature of hearing. A collection of accurate obſervations on the ſtructure of the ear would give us principles on which to proceed in explaining the various methods of producing external ſounds. The nature of *continued ſounds* might then be treated of, and would appear, we believe, very different from what it is commonly ſuppoſed. Under this head animal voices might be particularly conſidered, and the elements of human ſpeech properly aſcertained. When the production of continued ſounds is once ſhown to be a thing regulated by principle, it may be ſyſtematically treated, and this principle may be conſidered as combined with every mechanical ſtate of body that may be pointed out. This will ſuggeſt to us methods of producing ſound which have not yet been thought of, and may therefore give us ſounds with which we are unacquainted. Such an acquiſition is not to be deſpiſed nor rejected. The bountiful Author of our being and of all our faculties has made it an object of moſt enchanting reliſh to the human mind. The Greeks, the moſt cultivated people who have ever figured on the ſtage of life, enjoyed the pleaſures of muſic with rapture. Even the poor negro, after toiling a whole day beneath the tropical ſun, will go ten miles in the dark to dance all night to the ſimple muſic of the balafoe, and return without ſleep to his next day's toil. The penetrating eye of the anatomiſt has diſcovered in the human larynx an apparatus evidently contrived for tempering the great movements of the glottis, ſo as to enable us to produce the intended note with the utmoſt preciſion. There is no doubt therefore that the conſummate Artiſt has not thought it unworthy of his attention. We ought therefore to receive with thankfulneſs this preſent from our Maker—this *laborum dulce lenimen;* and it is ſurely worthy the attention of the philoſopher to add to this innocent elegance of life. This, however, is not the time to enter upon the ſubject. From the jarring obſervations which have yet been made, we could only amuſe the curious reader by holding up to his view a ſpecious theory; and we are not ſo deſirous of filling our Work with what is called *original matter*, as to attempt the attainment of that end by ſubſtituting fiction for fact and hypotheſis for ſcience.

Sound.

Sound, in geography, denotes in general any ſtrait or inlet of the ſea between two headlands. It is given by way of eminence to the ſtrait between Sweden and Denmark,

Sounding. Denmark, joining the German ocean to the Baltic, being about three miles over. See DENMARK, n° 32. and ELSINORE.

SOUNDING, the operation of trying the depth of the ſea, and the nature of the bottom, by means of a plummet ſunk from a ſhip to the bottom.

There are two plummets uſed for this purpoſe in navigation; one of which is called the *hand-lead*, weighing about 8 or 9 pounds; and the other the *deep ſea-lead*, which weighs from 25 to 30 pounds; and both are ſhaped like the fruſtum of a cone or pyramid. The former is uſed in ſhallow waters, and the latter at a great diſtance from the ſhore; particularly on approaching the land after a ſea-voyage. Accordingly the lines employed for this purpoſe are called the *deep-ſea lead-line*, and the *hand lead-line*.

The hand lead-line, which is uſually 20 fathoms in length, is marked at every two or three fathoms; ſo that the depth of the water may be aſcertained either in the day or night. At the depth of two and three fathoms, there are marks of black leather; at 5 fathoms, there is a white rag; at 7, a red rag; at 10, black leather; at 13, black leather; at 15, a white rag; and at 17, a red ditto.

Sounding with the hand lead, which is called *heaving the lead* by ſeamen, is generally performed by a man who ſtands in the main chains to windward. Having the line quite ready to run out without interruption, he holds it nearly at the diſtance of a fathom from the plummet; and having ſwung the latter backwards and forwards three or four times, in order to acquire the greater velocity, he ſwings it round his head, and thence as far forward as is neceſſary; ſo that, by the lead's ſinking whilſt the ſhip advances, the line may be almoſt perpendicular when it reaches the bottom. The perſon ſounding then proclaims the depth of the water in a kind of ſong reſembling the cries of hawkers in a city. Thus if the mark of five fathoms is cloſe to the ſurface of the water, he calls, 'By the mark five!' and as there is no mark at four, ſix, eight, &c. he eſtimates thoſe numbers, and calls, 'By the dip four,' &c. If he judges it to be a quarter or an half more than any particular number, he calls, 'And a quarter five! and a half four,' &c. If he conceives the depth to be three quarters more than a particular number, he calls it a quarter leſs than the next: thus, at four fathoms and three fourths he calls 'A quarter leſs five!' and ſo on.

The deep ſea-lead is marked with two knots at 20 fathoms, three at 30, four at 40, and ſo on to the end. It is alſo marked with a ſingle knot in the middle of each interval, as at 25, 35, 45 fathoms, &c. To uſe this lead more effectually at ſea, or in deep water on the ſea-coaſt, it is uſual previouſly to bring to the ſhip, in order to retard her courſe: the lead is then thrown as far as poſſible from the ſhip on the line of her drift, ſo that, as it ſinks, the ſhip drives more perpendicularly over it. The pilot, feeling the lead ſtrike the bottom, readily diſcovers the depth of the water by the mark on the line neareſt its ſurface. The bottom of the lead being alſo well rubbed over with tallow, retains the diſtinguiſhing marks of the bottom, as ſhells, ooze, gravel, &c. which naturally adhere to it.

The depth of the water, and the nature of the ground, which is called the *ſoundings*, are carefully marked in the log-book, as well to determine the diſtance of the place from the ſhore, as to correct the obſervations of former pilots.

Soup || South.

SOUP, a ſtrong decoction of fleſh or other ſubſtances.

Portable or dry ſoup is a kind of cake formed by boiling the gelatinous parts of animal ſubſtances till the watery parts are evaporated. This ſpecies of ſoup is chiefly uſed at ſea, and has been found of great advantage. The following receipt will ſhow how it is prepared. *Chaptal's Chemiſtry.*

Of calves feet take 4; leg of beef 12 lbs.; knuckle of veal 3 lbs.; and leg of mutton 10 lbs. Theſe are to be boiled in a ſufficient quantity of water, and the ſcum taken off as uſual; after which the ſoup is to be ſeparated from the meat by ſtraining and preſſure. The meat is then to be boiled a ſecond time in other water; and the two decoctions, being added together, muſt be left to cool, in order that the fat may be exactly ſeparated. The ſoup muſt then be clarified with five or ſix whites of eggs, and a ſufficient quantity of common ſalt added. The liquor is then ſtrained through flannel, and evaporated on the water-bath to the conſiſtence of a very thick paſte; after which it is ſpread rather thin upon a ſmooth ſtone, then cut into cakes, and laſtly dried in a ſtove until it becomes brittle: theſe cakes are kept in well cloſed bottles. The ſame proceſs may be uſed to make a portable ſoup of the fleſh of poultry; and aromatic herbs may be uſed as a ſeaſoning, if thought proper.

Theſe tablets or cakes may be kept four or five years. When intended to be uſed, the quantity of half an ounce is put into a large glaſs of boiling water, which is to be covered, and ſet upon hot aſhes for a quarter of an hour, or until the whole is entirely diſſolved. It forms an excellent ſoup, and requires no addition but a ſmall quantity of ſalt.

SOUR-CROUTE. See CROUTE.

Sour-Gourd, or *African Calabaſh-tree*. See ADANSONIA.

SOUTH (Dr Robert), an eminent divine, was the ſon of Mr William South a merchant of London, and was born at Hackney near that city in 1633. He ſtudied at Weſtminſter ſchool, and afterwards in Chriſt-church college, Oxford. In 1654, he wrote a copy of Latin verſes to congratulate Cromwell upon the peace concluded with the Dutch; and the next year a Latin poem, intitled *Muſica Incantans*. In 1660 he was elected public orator of the univerſity; and the next year became domeſtic chaplain to Edward earl of Clarendon, lord-high-chancellor of England. In 1663 he was inſtalled prebendary of Weſtminſter, admitted to the degree of doctor of divinity, and had a ſinecure beſtowed on him in Wales by his patron the earl of Clarendon; after whoſe retirement into France in 1667 he became chaplain to the duke of York. In 1670 he was inſtalled canon of Chriſt-church in Oxford; and in 1676 attended as chaplain to Laurence Hyde, Eſq; ambaſſador extraordinary to the king of Poland. In 1678 he was preſented to the rectory of Iſlip in Oxfordſhire; and in 1680 rebuilt the chancel of that church, as he afterwards did the rectory-houſe belonging to it. After the revolution he took the oath of allegiance to king William and queen Mary, though he excuſed himſelf from accepting a great dignity in the church, vacated by the perſonal refuſal of that oath. His health began to decline

South. cline ſeveral years before his death, which happened in 1716. He was interred in Weſtminſter Abbey, where a monument is erected to his memory. He publiſhed, 1. Animadverſions on Dr Sherlock's Vindication of the Holy and Ever Bleſſed Trinity. 2. A Defence of his Animadverſions. 3. Sermons, 8 vols 8vo. And after his deceaſe were publiſhed his *Opera Poſthuma Latina*, and his poſthumous Engliſh works. Dr South was remarkable for his wit, which abounds in all his writings, and particularly in his ſermons; but at the ſame time they equally abound in ill-humour, ſpleen, and ſatire. He was remarkable for being a time-ſerver. During the life of Cromwell he was a ſtaunch Preſbyterian, and then railed againſt the Independents: at the Reſtoration he exerted his pulpit-eloquence againſt the Preſbyterians; and in the reign of Queen Anne, was a warm advocate for Sacheverel.

SOUTH, one of the four cardinal points from which the winds blow.

SOUTH Sea, or *Pacific Ocean*, is that vaſt body of water interpoſed between Aſia and America. It does not however, ſtrictly ſpeaking, reach quite to the continent of Aſia, excepting to the northward of the peninſula of Malacca: for the water interpoſed between the eaſtern coaſt of Africa and the peninſula juſt mentioned has the name of the *Indian Ocean*. The South Sea then is bounded on one ſide by the weſtern coaſt of America, through its whole extent, from the unknown regions in the north to the ſtraits of Magellan and Terra del Fuego, where it communicates with the ſouthern part of the Atlantic. On the other ſide, it is bounded by the coaſt of Aſia, from the northern promontory of Tſchukotſkoi Noſs, to the peninſula of Malacca already mentioned. Thence it is bounded to the ſouthward by the northern coaſts of Borneo, Celebes, Macaſſar, New Guinea, New Holland, and the other iſlands in that quarter, which divide it from the Indian Ocean. Then, waſhing the eaſtern coaſt of the great iſland of New Holland, it communicates with that vaſt body of water encompaſſing the whole ſouthern part of the globe, and which has the general name of the *Southern Ocean* all round. Thus does this vaſt ocean occupy almoſt the ſemicircumference of the globe, extending almoſt from one pole to the other, and about the equatorial parts extending almoſt 180° in longitude, or 12,500 of our miles.

The northern parts of the Pacific Ocean are entirely deſtitute of land; not a ſingle iſland having yet been diſcovered in it from the latitude of 40° north and upwards, excepting ſuch as are very near the coaſt either of Aſia or America; but in the ſouthern part there are a great number.

Till very lately the South Sea was in a great meaſure unknown. From the great extent of ice which covers the ſouthern part of the globe, it was imagined that much more land exiſted there than in the northern regions: but that this could not be juſtly inferred merely from that circumſtance, is plain from what has been advanced under the article AMERICA, n° 3—24; and the ſouthern continent, long known by the name of *Terra Auſtralis*, has eluded the ſearch of the moſt expert navigators ſent out from Britain and France by royal authority. See TERRA AUSTRALIS.

SOUTH Sea Company. See COMPANY.

SOUTHAMPTON, a ſea-port town of Hampſhire in England. It is commodiouſly ſeated on an arm of the ſea; is a place of good trade, and well inhabited. It is ſurrounded by walls and ſeveral watch-towers, and had a ſtrong caſtle to defend the harbour, now in ruins. It is a corporation and a county of itſelf, with the title of an earldom, and ſends two members to parliament. W. Long. 1. 26. N. Lat. 50. 55. Southampton || Sozomenus.

SOUTHERN (Thomas), an eminent dramatic writer, was born at Dublin in 1660, and received his education in the univerſity there. He came young to London to ſtudy law; but inſtead of that devoted himſelf to poetry and the writing of plays. His Perſian Prince, or Loyal Brother, was introduced in 1682, when the Tory intereſt was triumphant in England; and the character of the loyal brother being intended to compliment James duke of York, he rewarded the author when he came to the throne with a commiſſion in the army. On the Revolution taking place, he retired to his ſtudies, and wrote ſeveral plays, from which he is ſuppoſed to have derived a very handſome ſubſiſtence, being the firſt who raiſed the advantage of play-writing to a ſecond and third night. The moſt finiſhed of all his plays is Oroonoko, or the Royal Slave, which is built on a true ſtory related in one of Mrs Behn's novels. Mr Southern died in 1746, in the 86th year of his age; the latter part of which he ſpent in a peaceful ſerenity, having, by his commiſſion as a ſoldier, and the profits of his dramatic works, acquired a handſome fortune; and being an exact economiſt, he improved what fortune he gained to the beſt advantage. He enjoyed the longeſt life of all our poets; and died the richeſt of them, a very few excepted. His plays are printed in two vols 12mo.

SOUTHERN Continent. See AMERICA, n° 3—24. and *TERRA Auſtralis*.

SOUTHERNWOOD, in botany. See ARTEMISIA.

SOUTHWARK, a town of Surry, and a ſuburb of the city of London, being ſeparated from that metropolis only by the Thames. See LONDON, n° 96.

SOW, in zoology. See SUS.

Sow, in the iron works, the name of the block or lump of metal they work at once in the iron furnace.

Sow-Thiſtle. See SONCHUS.

SOWING, in agriculture and gardening, the depoſiting any kind of ſeed in the earth for a future crop. See AGRICULTURE.

Drill-SOWING. See *DRILL-Sowing*.

SOY. See DOLICHOS.

SOZOMENUS (Hermias), an eccleſiaſtical hiſtorian of the 5th century, was born in Bethelia, a town of Paleſtine. He was educated for the law, and became a pleader at Conſtantinople. He wrote an Abridgment of Eccleſiaſtical Hiſtory, in two books, from the aſcenſion of our Saviour to the year 323. This compendium is loſt; but a continuation of it in nine books, written at greater length, down to the year 440, is ſtill extant. He ſeems to have copied Socrates, who wrote a hiſtory of the ſame period. The ſtyle of Sozomenus is perhaps more elegant; but in other reſpects he falls far ſhort of that writer, diſplaying throughout his whole book an amazing credulity and a ſuperſtitious attachment to monks and the monaſtic life. The

Spa. best edition of Sozomenus is that of Robert Stephen in 1544. He has been tranſlated and publiſhed by Valeſius, and republiſhed with additional notes by Reading at London, 1720, in 3 vols folio. Spa.

SPA, a town of Germany, in the circle of Weſtphalia and biſhopric of Liege, famous for its mineral waters, lies in E. Long. 5. 50. N. Lat. 50. 30. about 21 miles ſouth-eaſt from Liege, and 7 ſouth-weſt from Lomburg. It is ſituated at one end of a deep valley on the banks of a ſmall rivulet, and is ſurrounded on all ſides by high mountains. The ſides of theſe mountains next to Spa are rude and uncultivated, preſenting a rugged appearance as if ſhattered by the convulſions of earthquakes; but as they are ſtrewed with tall oaks and abundance of ſhrubs, the country around forms a wild, romantic, and beautiful landſcape. The acceſs to the town is very beautiful. The road winds over the mountains till it deſcends to their bottom, when it runs along a ſmooth valley for a mile or a mile and a half.

The town conſiſts of four ſtreets in form of a croſs, and contains about 400 inhabitants. Spa has no wealth to boaſt of. It can ſcarcely furniſh the neceſſaries of life to its own inhabitants during the winter, and almoſt all the luxuries which are requiſite for the great concourſe of affluent viſitors during the ſummer are carried from Liege by women. Its only ſource of wealth is its mineral waters. No ſooner does the warm ſeaſon commence, than crowds of valetudinarians arrive, as well as many other perſons who are attracted ſolely by the love of amuſement, and ſome from leſs honourable motives. The inhabitants, who ſpend ſeven or eight months of the year without ſeeing the face of a ſtranger, wait for the return of this period with impatience. The welcome ſound of the carriages brings multitudes from the town, either to gratify their curioſity, or to offer their ſervices in the hopes of ſecuring your employment while you remain at Spa. Immediately after your arrival your name and deſignation is added to the printed liſt of the annual viſitors; for which you pay a ſtated ſum to the bookſeller, who has a patent for this purpoſe from the prince biſhop of Liege. This liſt not only enables one to know at a glance whether any friends or acquaintance are reſiding there, but alſo to diſtinguiſh perſons of rank and faſhion from adventurers, who ſeldom have the effrontery to inſert their names.

There are two different ways of accommodating the viſitors at Spa with lodging and neceſſaries. People may either lodge at an hotel, where every thing is furniſhed them in a ſplendid and expenſive ſtyle; or they may take up their reſidence in private lodgings, from which they may ſend for proviſions to a cook's ſhop.

Among the people who viſit Spa, there are many perſons of the firſt rank and faſhion in Europe. Perhaps indeed there is no place in Europe to which ſo many kings and princes reſort; but it is alſo viſited by many ſelf-created nobility, who, under the titles of counts, barons, marquiſes, and knights, contrive by their addreſs and artifices, to prey upon the rich and unexperienced.

The manners eſtabliſhed at Spa are conducive both to health and amuſement. Every body riſes early in the morning, at ſix o'clock or before it, when a great many horſes ſtand ready ſaddled for thoſe who chooſe to drink the Sauveniere or Geronſtere waters at a little diſtance from Spa. After this healthy exerciſe a part of the company generally breakfaſt together at Vauxhall, a magnificent and ſpacious building. At this place a number of card-tables are opened every forenoon, round which many perſons aſſemble and play for ſtakes to a very conſiderable amount. A ball too is generally held once a week at Vauxhall, beſides two balls at the aſſembly rooms near the Pouhon in the middle of the town.

The moſt remarkable waters at Spa are, 1. The Pouhon, ſituated in the middle of the town; 2. The Sauveniere, a mile and a half eaſt from it; 3. Groiſbeck, near to the Sauveniere; 4. Tonnelet, ſituated a little to the left of the road which leads to the Sauveniere; 5. Geronſtere, two miles ſouth from Spa; 6. Wartroz, near to the Tonnelet; 7. Sarts or Niveſet, in the diſtrict of Sarts; 8. Chevron or Bru, in the principality of Slavelot; 9. Couve; 10. Beverſe; 11. Sige; 12. Geremont. Theſe four laſt are near Malmedy.

Dr Brownrigg was the firſt perſon who diſcovered that fixed air, or, as it is now generally called, *carbonic acid gas*, forms a principal ingredient in the compoſition of the Spa waters, and actually ſeparated a quantity of this elaſtic fluid, by expoſing it to different degrees of heat from 110° to 170° of Fahrenheit. From 20 ounces 7 drams and 14 grains apothecaries weight of the Pouhon water, he obtained 8 ounces 2 drams and 50 grains. Since June 1765, when Dr Brownrigg read a paper on this ſubject before the Royal Society of London, the waters of Spa have been often analyſed, but perhaps by none with more accuracy than by Dr Aſh, who publiſhed a book on the chemical and medicinal properties of theſe waters in 1788. We ſhall preſent his analyſis of the five principal ſprings in the following table.

Fountains.	Quantity of Water.	Ounce meaſures of Gas.	Solid contents.	Aerated Lime.	Aerated Magneſia.	Aerated Mineral Alkali.	Aerated Iron.	Selenite.	Aerated Vegetab. Alkali.
	Ounces.		Grains.						
Pouhon	33	35.75	16.25	2.75	9.50	2.25	1.75	—	—
Geronſtere	32.75	24.75	5.50	2.50	—	1.75	0.75	0.50	—
Sauveniere	32.50	33.50	3.75	1.50	—	0.75	0.50	—	1.
Groiſbeck	32.25	35.50	5.25	1.50	—	1.	0.75	—	2
Tonnelet	32.	40.75	2.00	0.25	—	0.75	1.	—	—

The

Spa. The Pouhon ſpring riſes from the hill to the north of Spa, which conſiſts of argillaceous ſchiſtus and ferrugineous ſlate. The other fountains riſe from the ſurrounding hills to the ſouth-eaſt, ſouth, weſt, and north-weſt of the town; and this ridge of mountains is formed of calcareous earths mixed with ſiliceous ſubſtances. The ſurface of the mountains is covered with woods, interſperſed with large boggy ſwamps filled with mud and water. The Pouhon is conſidered as the principal ſpring at Spa, being impregnated with a greater quantity of iron than any of the reſt, and containing more fixed air than any except the Tonnelet. It is from this ſpring that the Spa water for exportation is bottled; for which the demand is ſo great, that, according to the beſt information which Mr Thickneſſe could obtain, the quantity exported amounts to 200,000 or 250,000 bottles annually. This exported water is inferior in its virtue to that which is drunk on the ſpot; for the veſſels into which it is collected are injudiciouſly expoſed to the ſun, rain, wind, and duſt, for ſeveral hours before they are corked, by which means a conſiderable part of its volatile ingredients muſt be evaporated; for it has been found by experiment, that by expoſing it to a gentle heat, air-bubbles aſcend in great numbers. It is in its greateſt perfection when collected in cold dry weather; it is then pellucid, colourleſs, and without ſmell, and almoſt as light as diſtilled water. It varies in its heat from 52° or 53° to 67° of Fahrenheit's thermometer.

Thickneſſe's Journey through the Pais Bas.

The Geronſtere is a much weaker chalybeate water than the Pouhon; and as it is exceedingly nauſeous, and taſtes and ſmells like rotten eggs, it certainly contains ſome hepatic gas. This is a circumſtance which Dr Aſh ſeems not to have attended to ſufficiently. The Sauveniere water alſo, when newly taken from the well, ſmells a little of ſulphur. The Groiſbeck contains more alkali, and almoſt as much gas as the Pouhon, and has been celebrated for its good effects in the caſe of calculous concretions. The Tonnelet contains more gas than any of the reſt. So ſmall is the quantity of any foſſil body held in ſuſpenſion by the aerial acid in it, and ſo volatile is the gas, that it begins to paſs off very rapidly the moment it is taken out of the well, and in a ſhort time is entirely gone. Dr Aſh informs us, that in the neighbourhood of this well, the cellars, on any approaching change of weather, are found to contain much fixed air; and the beſt prognoſtic which they have of rain is the averſion which cats ſhow to be carried into theſe cellars.

The Spa waters are diuretic, and ſometimes purgative. They exhilarate the ſpirits with an influence much more benign than wine or ſpirituous liquors, and they are more cooling, and allay thirſt more effectually than common water. They are found beneficial in caſes of weakneſs and relaxation, either partial or univerſal; in nervous diſorders; in obſtructions of the liver and ſpleen; in caſes where the blood is too thin and putreſcent; in caſes of exceſſive diſcharges proceeding from weakneſs; in the gravel and ſtone; and in moſt caſes where a ſtrengthening remedy is wanted. But they are hurtful in confirmed obſtructions attended with fever, where there is no free outlet to the matter, as in ulcerations of the lungs. They are alſo injurious to bilious and plethoric conſtitutions, when uſed before the body is cooled by proper evacuations.

SPACE. See METAPHYSICS, Part II. Chap. iv.

Space. SPACE, in geometry, denotes the area of any figure, or that which fills the interval or diſtance between the lines that terminate it.

SPADIX, in botany, anciently ſignified the receptacle of the palms. It is now uſed to expreſs every flower-ſtalk that is protruded out of a ſpatha or ſheath.

The ſpadix of the palms is branched; that of all other plants ſimple. This laſt caſe admits of ſome variety: in calla, dracontium, and pothos, the florets cover it on all ſides; in arum, they are diſpoſed on the lower part only; and in zoſtera on one ſide.

SPAGIRIC ART, a name given by authors to that ſpecies of chemiſtry which works on metals, and is employed in the ſearch of the philoſopher's ſtone.

SPAHIS, horſemen in the Ottoman army, chiefly raiſed in Aſia. The great ſtrength of the grand ſeignior's army conſiſts in the janiſaries, who are the foot; and the ſpahis, who are the horſe.

SPAIN, a country of Europe, famous both in ancient and modern hiſtory, ſituated in that large peninſula which forms the ſouth-weſtern part of Europe. It is bounded on the ſouth and eaſt by the Mediterranean ſea and ſtraits of Gibraltar, on the north and weſt by the Bay of Biſcay and Atlantic Ocean, on the ſouth-weſt by Portugal, and on the north-eaſt by the Pyrenees.

1 Different names of Spain.

The moſt ancient name of Spain was *Iberia*, ſuppoſed by ſome to be derived from the *Iberians*, a people inhabiting Mount Caucaſus, a colony of whom ſettled in this country. Others derive it from the Phenician word *Ebra* or *Ibra*, ſignifying a paſſage or limit. By the Romans it was called *Spania* or *Hiſpania*, from the Phenician name *Sphanija*; and this again from *ſhaphan*, a Phenician word ſignifying a rabbit, becauſe the weſtern part of Spain abounded with thoſe animals.

Spain, as well as the reſt of Europe, was probably peopled by the Celtes; but the Spaniſh hiſtorians derive the origin of their nation from Tubal the fifth ſon of Japhet, aſſerting that Spain had been a monarchy for 2226 years before the coming of the Celtes into it. Till the coming of the Carthaginians into Spain, however, nothing certain can be affirmed of the Spaniards; and this happened not long before the commencement of the firſt Punic war. Their ſucceſs in reducing the country, and their final expulſion by the Romans, has already been related under the articles ROME and CARTHAGE; we have here therefore only to take notice of the ſtate of Spain under the Roman government, until the Romans were in their turn expelled by the northern barbarians.

2 Conqueſts of the Carthaginians in Spain.

At the time of the Roman conqueſt, Spain, though prodigious quantities of ſilver had been carried out of it by the Carthaginians and Tyrians, was yet a very rich country. In the moſt ancient times, indeed, its riches are ſaid to have exceeded what is related of the moſt wealthy country in America. Ariſtotle aſſures us, that when the Phenicians firſt arrived in Spain, they exchanged their naval commodities for ſuch immenſe quantities of ſilver, that their ſhips could neither contain nor ſuſtain its load, though they uſed it for ballaſt, and made their anchors and other implements of ſilver. When the Carthaginians firſt came to Spain, they found the quantity of ſilver nothing leſſened, ſince the inhabitants at that time made all their utenſils, and even

3 Exceeding great riches of the country.

Spain. mangers, of that precious metal. In the time of the Romans this amazing plenty was very much diminiſhed; however, their gleanings were by no means deſpicable, ſince in the ſpace of nine years they carried off 111,542 pounds of ſilver, and 4095 of gold, beſides an immenſe quantity of coin and other things of value. The Spaniards were always remarkable for their bravery, and ſome of Hannibal's beſt troops were brought from thence. But as the Romans penetrated farther into the country than the Carthaginians had done, they met with nations whoſe love of liberty was equal to their valour, and whom the whole ſtrength of their empire was ſcarce able to ſubdue. Of theſe the moſt formidable were the Numantines, Cantabrians, and Aſturians.

4 Viriathus oppoſes the Roman power with ſucceſs.

In the time of the third Punic war, one Viriathus, a celebrated hunter, and afterwards the captain of a gang of banditti, took upon him the command of ſome nations who had been in alliance with Carthage, and ventured to oppoſe the Roman power in that part of Spain called *Luſitania*, now Portugal. The prætor, named *Vetilius*, who commanded in thoſe parts, marched againſt him with 10,000 men; but was defeated and killed, with the loſs of 4000 of his troops. The Romans immediately diſpatched another prætor with 10,000 foot and 1300 horſe: but Viriathus having firſt cut off a detachment of 4000 of them, engaged the reſt in a pitched battle; and having entirely defeated them, reduced great part of the country. Another prætor, who was ſent with a new army, met with the ſame fate; ſo that, after the deſtruction of Carthage, the Romans thought proper to ſend a conſul named *Quintus Fabius*, who defeated the Luſitanians in ſeveral battles, and regained two important places which had long been in the hands of the rebels. After the expiration of Fabius's conſulate, Viriathus continued the war with his uſual ſucceſs, till the ſenate thought proper to ſend againſt him the conſul Q. Cæcilius Metellus, an officer of great valour and experience. With him Viriathus did not chooſe to venture a pitched battle, but contented himſelf with acting on the defenſive; in conſequence of which the Romans recovered a great many cities, and the whole of Tarraconian Spain was obliged to ſubmit to their yoke. The other conſul, named *Servilianus*, did not meet with the ſame ſucceſs; his army was defeated in the field and his camp was nearly taken by Viriathus. Notwithſtanding the good fortune of Metellus, however, he could not withſtand the intrigues of his countrymen againſt him, and he was not allowed to finiſh the war he had begun with ſo much ſucceſs. In reſentment for this he took all imaginable pains to weaken the army under his command: he diſbanded the flower of his troops, exhauſted the magazines, let the elephants die, broke in pieces the arrows which had been provided for the Cretan archers, and threw them into a river. Yet, after all, the army which he gave up to his ſucceſſor Q. Pompeius, conſiſting of 30,000 foot and 2000 horſe, was ſufficient to have cruſhed Viriathus if the general had known how to uſe it. But, inſtead of oppoſing Viriathus with ſucceſs, the imprudent conſul procured much more formidable enemies. The Termantians and Numantines, who had hitherto kept themſelves independent, offered very advantageous terms of peace and alliance with Rome; but Pompeius inſiſted on their delivering up their arms. Upon this, war was immediately commenced. The conſul with great confidence inveſted Numantia; but being repulſed with conſiderable loſs, he ſat down before Termantia, where he was attended with ſtill worſe ſucceſs. The very firſt day, the Termantines killed 700 of his legionaries; took a great convoy which was coming to the Roman camp; and having defeated a conſiderable body of their horſe, puſhed them from poſt to poſt till they came to the edge of a precipice, where they all tumbled down, and were daſhed to pieces. In the mean time Servilian, who had been continued in his command with the title of *proconſul*, managed matters ſo ill, that Viriathus ſurrounded him on all ſides, and obliged him to ſue for peace. The terms offered to the Romans were very moderate; being only that Viriathus ſhould keep the country he at that time poſſeſſed, and the Romans remain maſters of all the reſt. This peace the proconſul was very glad to ſign, and afterwards got it ſigned by the ſenate and people of Rome.

Spain.

7 The Romans ſurrounded on all ſides, and forced to conclude a peace with Viriathus.

The next year Q. Pompeius was continued in his command againſt the Numantines in Farther Spain, while Q. Servilius Cæpio, the new conſul, had for his province Hither Spain, where Viriathus had eſtabliſhed his new ſtate. Pompeius undertook to reduce Numantia by turning aſide the ſtream of the Durius, now the Douro, by which it was ſupplied with water; but, in attempting this, ſuch numbers of his men were cut off, that, finding himſelf unable to contend with the enemy, he was glad to make peace with them on much worſe terms than they had offered of their own accord. The peace, however, was ratified at Rome; but in the mean time Cæpio, deſirous of ſhowing his proweſs againſt the renowned Viriathus, prevailed upon the Romans to declare war againſt him without any provocation. As Cæpio commanded an army greatly ſuperior to the Luſitanians, Viriathus thought proper to ſue for peace; but finding that Cæpio would be ſatisfied with nothing leſs than a ſurrender at diſcretion, he reſolved to ſtand his ground. In the mean time, the latter having bribed ſome of the intimate companions of Viriathus to murder him in his ſleep, he by that infamous method put an end to a war which had laſted 14 years, very little to the honour of the republic.

7 Viriathus treacherouſly murdered.

After the death of Viriathus, the Romans with like treachery ordered their new conſul Popilius to break the treaty with the Numantines. His infamous conduct met with the reward it deſerved; the Numantines ſallying out, put the whole Roman army to flight with ſuch ſlaughter, that they were in no condition to act during the whole campaign. Mancinus, who ſucceeded Popilius, met with ſtill worſe ſucceſs; his great army, conſiſting of 30,000 men, was utterly defeated by 4000 Numantines, and 20,000 of them killed in the purſuit. The remaining 10,000, with their general, were pent up by the Numantines in ſuch a manner that they could neither advance nor retreat, and would certainly have been all put to the ſword or made priſoners, had not the Numantines, with a generoſity which their enemies never poſſeſſed, offered to let them depart upon condition that a treaty ſhould be concluded with them upon very moderate terms. This the conſul very willingly promiſed, but found himſelf unable to perform. On the contrary, the people, not ſatisfied with declaring his treaty null and void, ordered him to be delivered up to the Numantines. The latter refuſed to accept him, unleſs

8 The Romans defeated by the Numantines.

5 Is reduced to great ſtraits by Metellus.

6 War between the Romans and Numantines.

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BAY OF BISCAY

ATLANTIC OCEAN

MEDITERRANEAN SEA

FRANCE

British Statute Miles
10 20 40

44 43 42 41 40 39 38 37 36

C. Ortegal · St. Sibrian · C. de Finas · Santilane · St. Andero · Lavedo · C. Machichaco · St. Sebastian · St. Jean de Luz · Fontarabia · Bourdeaux · Garone R. · Thoulose · Montpellier · Rhone R.

Ferrol · Corruna · C. Bellum · C. Finisterre · Rivadavia · Mondonedo · Avilos · Oviedo · Greym · Belancos · St. Jago · Lugo · Mareſs · St. Vincent · P. Callette · Bilboa · Bayonne · Narbone

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Spain.

leſs he had along with him the 10,000 men whom they had relieved as above related. At laſt, after the conſul had remained a whole day before the city, his ſucceſſor Furius, thinking this a ſufficient recompenſe to the Numantines for breaking the treaty, ordered him to be received again into the camp. However, Furius did not chooſe to engage with ſuch a deſperate and reſolute enemy as the Numantines had ſhowed themſelves; and the war with them was diſcontinued till the year 133 B. C. when Scipio Æmilianus, the deſtroyer of Carthage, was ſent againſt them. Againſt this renowned commander the Numantines with all their valour were not able to cope. Scipio, having with the utmoſt care introduced ſtrict diſcipline among his troops, and reformed the abuſes which his predeceſſors had ſuffered in their armies, by degrees brought the Romans to face their enemies, which at his arrival they had abſolutely refuſed to do. Having then ravaged all the country round about the town, it was ſoon blocked up on all ſides, and the inhabitants began to feel the want of proviſions. At laſt they reſolved to make one deſperate attempt for their liberty, and either to break through their enemies, or periſh in the attempt. With this view they marched out in good order by two gates, and fell upon the works of the Romans with the utmoſt fury. The Romans, unable to ſtand this deſperate ſhock, were on the point of yielding; but Scipio, haſtening to the places attacked, with no fewer than 20,000 men, the unhappy Numantines were at laſt driven into the city, where they ſuſtained for a little longer the miſeries of famine. Finding at laſt, however, that it was altogether impoſſible to hold out, it was reſolved by the majority to ſubmit to the pleaſure of the Roman commander. But this reſolution was not univerſally approved. Many ſhut themſelves up in their houſes, and died of hunger, while even thoſe who had agreed to ſurrender repented their offer, and ſetting fire to their houſes, periſhed in the flames with their wives and children, ſo that not a ſingle Numantine was left alive to grace the triumph of the conqueror of Carthage.

9 Scipio Æmilianus ſent againſt them.

10 Miſerable end of the people.

After the deſtruction of Numantia the whole of Spain ſubmitted to the Roman yoke; and nothing remarkable happened till the times of the Cimbri, when a prætorian army was cut off in Spain by the Luſitanians. From this time nothing remarkable occurs in the hiſtory of Spain till the civil war between Marius and Sylla. The latter having cruſhed the Marian faction, as related under the article ROME, proſcribed all thoſe that had ſided againſt him whom he could not immediately deſtroy. Among theſe was Sertorius, a man of conſummate valour and experience in war. He had by Marius been appointed prætor of Spain, and upon the overthrow of Marius, retired to that province. Sylla no ſooner heard of his arrival in that country, than he ſent thither one Caius Annius with a powerful army to drive him out. As Sertorius had but few troops along with him, he diſpatched one Julius Salinator with a body of 6000 men to guard the paſſes of the Pyrenees, and to prevent Annius from entering the country. But Salinator having been treacherouſly murdered by aſſaſſins hired by Annius for that purpoſe, he no longer met with any obſtacle; and Sertorius was obliged to embark for the coaſt of Africa with 3000 men, being all he had now remaining. With theſe he landed in Mauritania; but as his men were ſtraggling careleſsly about, great numbers of them were cut off by the Barbarians. This new misfortune obliged Sertorius to re-embark for Spain; but finding the whole coaſt lined with the troops of Annius, he put to ſea again, not knowing what courſe to ſteer. In this new voyage he met with a ſmall fleet of Cilician pirates; and having prevailed with them to join him, he made a deſcent on the coaſt of Yvica, overpowered the garriſon left there by Annius, and gained a conſiderable booty. On the news of this victory Annius ſet ſail for Yvica, with a conſiderable ſquadron, having 5000 land forces on board. Sertorius, not intimidated by the ſuperiority of the enemy, prepared to give them battle. But a violent ſtorm ariſing, moſt of the ſhips were driven on ſhore and daſhed to pieces, Sertorius himſelf with great difficulty eſcaping with the ſmall remains of his fleet. For ſome time he continued in great danger, being prevented from putting to ſea by the fury of the waves, and from landing by the enemy; at laſt, the ſtorm abating, he paſſed the ſtraits of Gades, now Gibraltar, and landed near the mouth of the river Bætis. Here he met with ſome ſeamen newly arrived from the Atlantic or Fortunate Iſlands; and was ſo taken with the account which they gave him of thoſe happy regions, that he reſolved to retire thither to ſpend the reſt of his life in quiet and happineſs. But having communicated this deſign to the Cilician pirates, they immediately abandoned him, and ſet ſail for Africa, with an intention to aſſiſt one of the barbarous kings againſt his ſubjects who had rebelled. Upon this Sertorius ſailed thither alſo, but took the oppoſite ſide; and having defeated the king named *Aſcalis*, obliged him to ſhut himſelf up in the city of Tingis, now Tangier, which he cloſely beſieged. But in the mean time Pacianus, who had been ſent by Sylla to aſſiſt the king, advanced with a conſiderable army againſt Sertorius. Upon this the latter, leaving part of his forces before the city, marched with the reſt to meet Pacianus, whoſe army, though greatly ſuperior to his own in number, he entirely defeated; killed the general, and took all his forces priſoners.—The fame of this victory ſoon reached Spain; and the Luſitanians, being threatened with a new war from Annius, invited Sertorius to head their armies. With this requeſt he very readily complied, and ſoon became very formidable to the Romans. Titus Didius, governor of that part of Spain called *Bætica*, firſt entered the liſts with him; but he being defeated, Sylla next diſpatched Metellus, reckoned one of the beſt commanders in Rome, to ſtop the progreſs of this new enemy. But Metellus, notwithſtanding all his experience, knew not how to act againſt Sertorius, who was continually changing his ſtation, putting his army into new forms, and contriving new ſtratagems. On his firſt arrival he ſent for L. Domitius, then prætor of Hither Spain, to his aſſiſtance; but Sertorius being informed of his march, detached Hirtuleius, or Herculeius, his quæſtor, againſt him, who gave him a total overthrow. Metellus then diſpatched Lucius Lollius prætor of Narbonne Gaul againſt Hirtuleius; but he met with no better ſucceſs, being utterly defeated, and his lieutenant-general killed.

11 Sertorius ſupports the Marian faction in Spain.

12 Is driven out, and undergoes many hardſhips.

Spain.

13 Lands in Africa, and carries on a ſucceſsful war in that country.

14 Returns to Spain, and defeats the Romans there.

The fame of theſe victories brought to the camp of Sertorius ſuch a number of illuſtrious Roman citizens of the Marian faction, that he formed a deſign of erecting Luſitania into a republic in oppoſition to that of Rome. Sylla was continually ſending freſh ſupplies to

15 Erects Luſitania into a republic.

Metellus;

Spain. Metellus; but Sertorius with an handful of men, accuſtomed to range about the mountains, to endure hunger and thirſt, and live expoſed to the inclemencies of the weather, ſo haraſſed the Roman army, that Metellus himſelf began to be quite diſcouraged. At laſt, Sertorius, hearing that Metellus had ſpoken diſreſpectfully of his courage, challenged his antagoniſt to end the war by ſingle combat; but Metellus very prudently declined the combat, as being advanced in years; yet this refuſal brought upon him the contempt of the unthinking multitude, upon which Metellus reſolved to retrieve his reputation by ſome ſignal exploit, and therefore laid ſiege to Lacobriga, a conſiderable city in thoſe parts. This he hoped to reduce in two days, as there was but one well in the place; but Sertorius, having previouſly removed all thoſe who could be of no ſervice during the ſiege, and conveyed 6000 ſkins full of water into the city, Metellus continued a long time before it without making any impreſſion. At laſt, his proviſions being almoſt ſpent, he ſent out Aquinus at the head of 6000 men to procure a new ſupply; but Sertorius falling unexpectedly upon them, cut in pieces or took the whole detachment; the commander himſelf being the only man who eſcaped to carry the news of the diſaſter; upon which Metellus was obliged to raiſe the ſiege with diſgrace.

16 Obliges Metellus to raiſe the ſiege of Lacobriga.

17 Civilizes the Luſitanians.

And now Sertorius, having gained ſome intervals of eaſe in conſequence of the many advantages he had obtained over the Romans, began to civilize his new ſubjects. Their ſavage and furious manner of fighting he changed for the regular order and diſcipline of a well-formed army; he beſtowed liberally upon them gold and ſilver to adorn their arms, and by converſing familiarly with them, prevailed upon them to lay aſide their own dreſs for the Roman *toga*. He ſent for all the children of the principal people, and placed them in the great city of Oſca, now Hereſca, in the kingdom of Arragon, where he appointed them maſters to inſtruct them in the Roman and Greek learning, that they might, as he pretended, be capable of ſharing with him the government of the republic. Thus he made them really hoſtages for the good behaviour of their parents; however, the latter were greatly pleaſed with the care he took of their children, and all Luſitania were in the higheſt degree attached to their new ſovereign. This attachment he took care to heighten by the power of ſuperſtition; for having procured a young hind of a milk-white colour, he made it ſo tame that it followed him wherever he went; and Sertorius gave out to the ignorant multitude, that this hind was inſpired by Diana, and revealed to him the deſigns of his enemies, of which he always took care to be well informed by the great numbers of ſpies he employed.

While Sertorius was thus employed in eſtabliſhing his authority, the republic of Rome, alarmed at his ſucceſs, reſolved to cruſh him at all events. Sylla was now dead, and all the eminent generals in Rome ſolicited this honourable though dangerous employment. After much debate a decree was paſſed in favour of Pompey the Great, but without recalling Metellus. In the mean time, the troops of one Perpenna, or Perperna, had, in ſpite of all that their general could do, abandoned him and taken the oath of allegiance to Sertorius. This was a moſt ſignal advantage to Sertorius; for Perperna commanded an army of 33,000 men, and had

18 Pompey the Great ſent againſt him.

come into Spain with a deſign to ſettle there as Sertorius had done; but as he was deſcended from one of the firſt families in Rome, he thought it below his dignity to ſerve under any general, however eminent he might be. But the troops of Perperna were of a different opinion; and therefore declaring that they would ſerve none but a general who could defend himſelf, they to a man joined Sertorius; upon which Perperna himſelf, finding he could do no better, conſented to ſerve alſo as a ſubaltern. Spain.

On the arrival of Pompey in Spain, ſeveral of the cities which had hitherto continued faithful to Sertorius began to waver; upon which the latter reſolved, by ſome ſignal exploit, to convince them that Pompey could no more ſcreen them from his reſentment than Metellus. With this view he laid ſiege to Lauron, now Lirias, a place of conſiderable ſtrength. Pompey, not doubting but he ſhould be able to raiſe the ſiege, marched quite up to the enemy's lines, and found means to inform the garriſon that thoſe who beſieged them were themſelves beſieged, and would ſoon be obliged to retire with loſs and diſgrace. On hearing this meſſage, "I will teach Sylla's diſciple (ſaid Sertorius), that it is the duty of a general to look behind as well as before him." Having thus ſpoken, he ſent orders to a detachment of 6000 men, who lay concealed among the mountains, to come down and fall upon his rear if he ſhould offer to force the lines. Pompey, ſurpriſed at their ſudden appearance, durſt not ſtir out of his camp; and in the mean time the beſieged, deſpairing of relief, ſurrendered at diſcretion; upon which Sertorius granted them their lives and liberty, but reduced their city to aſhes.

19 Sertorius beſieges Laurou.

20 Takes and burns it in the ſight of Pompey.

While Sertorius was thus ſucceſsfully contending with Pompey, his quæſtor Hirtuleius was entirely defeated by Metellus, with the loſs of 20,000 men; upon which Sertorius advanced with the utmoſt expedition to the banks of the Sucro in Tarraconian Spain, with a deſign to attack Pompey before he could be joined by Metellus. Pompey, on his part, did not decline the combat; but, fearing that Metellus might ſhare the glory of the victory, advanced with the greateſt expedition. Sertorius put off the battle till towards the evening; Pompey, though he knew that the night would prove diſadvantageous to him, whether vanquiſhed or victorious, becauſe his troops were unacquainted with the country, reſolved to venture an engagement, eſpecially as he feared that Metellus might arrive in the mean time, and rob him of part of the glory of conquering ſo great a commander. Pompey, who commanded his own right wing, ſoon obliged Perperna, who commanded Sertorius's left, to give way. Hereupon Sertorius himſelf taking upon him the command of that wing, brought back the fugitives to the charge, and obliged Pompey to fly in his turn. In his flight he was overtaken by a gigantic African, who had already lifted up his hand to diſcharge a blow at him with his broad ſword; but Pompey prevented him by cutting off his right hand at one blow. As he ſtill continued his flight, he was wounded and thrown from his horſe; ſo that he would certainly have been taken priſoner, had not the Africans who purſued him quarrelled about the rich furniture of his horſe. This gave an opportunity to the general to make his eſcape; ſo that at length he reached his camp with much difficul-

21 Defeats Pompey on the banks of the Sucro.

Spain.

ty. But in the mean time Afranius, who commanded the left wing of the Roman army, had entirely defeated the wing which Sertorius had left, and even purſued them ſo cloſe that he entered the camp along with them. Sertorius, returning ſuddenly, found the Romans buſy in plundering the tents; when, taking advantage of their ſituation, he drove them out with great ſlaughter, and retook his camp. Next day he offered battle a ſecond time to Pompey; but Metellus then coming up with all his forces, he thought proper to decline an engagement with both commanders. In a few days, however, Pompey and Metellus agreed to attack the camp of Sertorius. Metellus attacked Perperna, and Pompey fell upon Sertorius. The event was ſimilar to that of the former battle; Metellus defeated Perperna, and Sertorius routed Pompey. Being then informed of Perperna's misfortune, he haſtened to his relief; rallied the fugitives, and repulſed Metellus in his turn, wounded him with his lance, and would certainly have killed him, had not the Romans, aſhamed to leave their general in diſtreſs, haſtened to his aſſiſtance, and renewed the fight with great fury. At laſt Sertorius was obliged to quit the field, and retire to the mountains. Pompey and Metellus haſtened to beſiege him; but while they were forming their camp, Sertorius broke through their lines, and eſcaped into Luſitania. Here he ſoon raiſed ſuch a powerful army, that the Roman generals, with their united forces, did not think proper to venture an engagement with him. They could not, however, reſiſt the perpetual attacks of Sertorius, who now drove them from place to place, till he obliged them to ſeparate, the one went into Gaul, and the other to the foot of the Pyrenees.

22 Pompey defeated a ſecond time.

23 Pompey and Metellus driven out of Spain by Sertorius.

Thus did this celebrated commander triumph over all the power of the Romans; and there is little doubt but he would have continued to make head againſt all the other generals whom the republic could have ſent; had he not been aſſaſſinated at an entertainment by the infamous treachery of Perperna, in 73 B. C. after he had made head againſt the Roman forces for almoſt ten years. Pompey was no ſooner informed of his death, than, without waiting for any new ſuccours, he marched againſt the traitor, whom he eaſily defeated and took priſoner; and having cauſed him to be executed, thus put an end, with very little glory, to a moſt dangerous war.

24 Sertorius treacherouſly murdered.

Many of the Spaniſh nations, however, ſtill continued to bear the Roman yoke with great impatience; and as the civil wars which took place firſt between Julius Cæſar and Pompey, and afterwards between Octavianus and Antony, diverted the attention of the republic from Spain, by the time that Auguſtus had become ſole maſter of the Roman empire, they were again in a condition to aſſert their liberty. The CANTABRIANS and ASTURIANS were the moſt powerful and valiant nations at that time in Spain; but, after incredible efforts, they were obliged to lay down their arms, or rather were almoſt exterminated, by Agrippa, as is related under theſe articles. From this time the Spaniards continued in quiet ſubjection to the Romans; but on the decline of the empire they were attacked by the northern nations, who put an end to the Roman name in the weſt. As the inhabitants had by that time entirely loſt their ancient valour, the barbarians met with no reſiſtance but from one another. In the reign of the emperor Honorius, the Vandals, Alans, and Suevians, entered this country; and having made themſelves maſters of it, divided the provinces among themſelves. In 444 the Romans made one effort more to recover their power in this part of the world; but being utterly defeated by the Suevians, the latter eſtabliſhed a kingdom there which laſted till the year 584, when it was utterly overthrown by the Viſigoths under Leovigilde. The Gothic princes continued to reign over a conſiderable part of Spain till the beginning of the 8th century, when their empire was entirely overthrown by the Saracens. During this period, they had entirely expelled the eaſtern emperors from what they poſſeſſed in Spain, and even made conſiderable conqueſts in Barbary; but towards the end of the 7th century the Saracens overran all that part of the world with a rapidity which nothing could reſiſt; and having ſoon poſſeſſed themſelves of the Gothic dominions in Barbary, they made a deſcent upon Spain about the year 711 or 712. The king of the Goths at that time was called *Roderic*, and by his bad conduct had occaſioned great diſaffection among his ſubjects. He therefore determined to put all to the iſſue of a battle, knowing that he could not depend upon the fidelity of his own people if he allowed the enemy time to tamper with them. The two armies met in a plain near Xeres in Andaluſia. The Goths began the attack with great fury; but though they fought like men in deſpair, they were at laſt defeated with exceſſive ſlaughter, and their king himſelf was ſuppoſed to have periſhed in the battle, being never more heard of.

26 Seized by barbarous nations on the decline of the weſternempire.

27 The Gothic kingdom overthrown by the Saracens.

By this battle the Moors in a ſhort time rendered themſelves maſters of almoſt all Spain. The poor remains of the Goths were obliged to retire into the mountainous parts of Aſturias, Burgos, and Biſcay: the inhabitants of Arragon, Catalonia, and Navarre, though they might have made a conſiderable ſtand againſt the enemy, choſe for the moſt part to retire into France. In 718, however, the power of the Goths began again to revive under Don Pelagio or Pelayo, a prince of the royal blood, who headed thoſe that had retired to the mountains after the fatal battle of Xeres. The place where he firſt laid the foundation of his government was in the Aſturias, in the province of Liebana, about nine leagues in length and four in breadth. This is the moſt inland part of the country, full of mountains enormouſly high, and ſo much fortified by nature, that its inhabitants are capable of reſiſting almoſt any number of invaders. Alakor the Saracen governor was no ſooner informed of this reviſal of the Gothiſh kingdom, than he ſent a powerful army, under the command of one Alchaman, to cruſh Don Pelagio before he had time to eſtabliſh his power. The king, though his forces were ſufficiently numerous (every one of his ſubjects arrived at man's eſtate being a ſoldier), did not think proper to venture a general engagement in the open field; but taking poſt with part of them himſelf in a cavern in a very high mountain, he concealed the reſt among precipices, giving orders to them to fall upon the enemy as ſoon as they ſhould perceive him attacked by them. Theſe orders were punctually executed, though indeed Don Pelagio himſelf had repulſed his enemies, but not without a miracle, as the Spaniſh hiſtorians pretend. The ſlaughter was dreadful; for the troops who lay in ambuſcade joining the reſt,

28 The power of the Goths reviſes under Pelagio.

29 He gives the Saracens a dreadful overthrow,

25 Spain entirely reduced by the Romans.

Spain.

reſt, and rolling down huge ſtones from the mountains upon the Moors (the name by which the Saracens were known in Spain), no fewer than 124,000 of theſe unhappy people periſhed in one day. The remainder fled till they were ſtopped by a river, and beginning to coaſt it, part of a mountain ſuddenly fell down, ſtopped up the channel of the river, and either cruſhed or drowned, by the ſudden riſing of the water, almoſt every one of that vaſt army.

30 Another army cut in pieces or taken.

The Moors were not ſo much diſheartened by this diſaſter, but that they made a ſecond attempt againſt Don Pelagio. Their ſucceſs was as bad as ever, the greateſt part of their army being cut in pieces or taken; in conſequence of which, they loſt all the Aſturias, and never dared to enter the liſts with Pelagio afterwards. Indeed, their bad ſucceſs had in a great meaſure taken from them the deſire of conquering a country where little or nothing was to be got; and therefore they rather directed their force againſt France, where they hoped for more plunder. Into this country they poured in prodigious multitudes; but were utterly defeated, in 732, by Charles Martel, with the loſs of 300,000 men, as the hiſtorians of thoſe times pretend.

31 The Saracens utterly defeated by Charles Martel.

Don Pelagio died in 737, and ſoon after his death ſuch inteſtine diviſions broke out among the Moors, as greatly favoured the increaſe of the Chriſtian power. In 745 Don Alonſo the Catholic, ſon-in-law to Pelagio, in conjunction with his brother Froila, paſſed the mountains, and fell upon the northern part of Galicia; and meeting with little reſiſtance, he recovered almoſt the whole of that province in a ſingle campaign. Next year he invaded the plains of Leon and Caſtile; and before the Moors could aſſemble any force to oppoſe him, he reduced Aſtorgas, Leon, Saldagna, Montes de Oca, Amaya, Alava, and all the country at the foot of the mountains. The year following he puſhed his conqueſts as far as the borders of Portugal, and the next campaign ravaged the country as far as Caſtile. Being ſenſible, however, that he was yet unable to defend the flat country which he had conquered, he laid the whole of it waſte, obliged the Chriſtians to retire to the mountains, and carried off all the Moors for ſlaves. Thus ſecured by a deſert frontier, he met with no interruption for ſome years; during which time, as his kingdom advanced in ſtrength, he allowed his ſubjects gradually to occupy part of the flat country, and to rebuild Leon and Aſtorgas, which he had demoliſhed. He died in 757, and was ſucceeded by his ſon Don Froila. In his time Abdelrahman, the khaliff's viceroy in Spain, threw off the yoke, and rendered himſelf independent, fixing the ſeat of his government at Cordova. Thus the inteſtine diviſions among the Moors were compoſed; yet their ſucceſs ſeems to have been little better than before; for, ſoon after, Froila encountered the Moors with ſuch ſucceſs, that 54,000 of them were killed on the ſpot, and their general taken priſoner. Soon after he built the city of Oviedo, which he made the capital of his dominions, in order to be in a better condition to defend the flat country, which he now determined to people.

32 Conqueſts of the Chriſtians.

33 The Saracens in Spain throw off the yoke of the khaliff.

In the year 758 the power of the Saracens received another blow by the riſe of the kingdom of Navarre. This kingdom, we are told, took its origin from an accidental meeting of gentlemen, to the number of 600, at the tomb of an hermit named *John*, who had died among the Pyrenees. At this place, where they had met on account of the ſuppoſed ſanctity of the deceaſed, they took occaſion to converſe on the cruelty of the Moors, the miſeries to which the country was expoſed, and the glory that would reſult from throwing off their yoke; which, they ſuppoſed, might eaſily be done, by reaſon of the ſtrength of their country. On mature deliberation, the project was approved; one Don Garcia Ximenes was appointed king, as being of illuſtrious birth, and looked upon as a perſon of great abilities. He recovered Ainſa, one of the principal towns of the country, out of the hands of the infidels, and his ſucceſſor Don Garcia Inigas extended his territories as far as Biſcay; however, the Moors ſtill poſſeſſed Portugal, Murcia, Andaluſia, Valentia, Granada, Tortoſa, with the interior part of the country as far as the mountains of Caſtile and Saragoſſa. Their internal diſſenſions, which revived after the death of Abdelrahman, contributed greatly to reduce the power of the infidels in general. In 778, Charles the Great being invited by ſome diſcontented Mooriſh governors, entered Spain with two great armies; one paſſing through Catalonia, and the other through Navarre, where he puſhed his conqueſts as far as the Ebro. On his return he was attacked and defeated by the Moors; though this did not hinder him from keeping poſſeſſion of all thoſe places he had already reduced. At this time he ſeems to have been maſter of Navarre: however, in 831 count Azner, revolting from Pepin ſon to the emperor Louis, again revived the independency of Navarre; but the ſovereigns did not aſſume the title of kings till the time of Don Garcia, who began to reign in 857.

34 Hiſtory of the kingdom of Navarre.

35 Conqueſts of Charles the Great

In the mean time, the kingdom founded by Don Pelagio, now called the kingdom of *Leon* and *Oviedo*, continued to increaſe rapidly in ſtrength, and many advantages were gained over the Moors, who having two enemies to contend with, loſt ground every day. In 921, however, they gained a great victory over the united forces of Navarre and Leon, by which the whole force of the Chriſtians in Spain muſt have been entirely broken, had not the victors conducted their affairs ſo wretchedly, that they ſuffered themſelves to be almoſt entirely cut in pieces by the remains of the Chriſtian army. In ſhort, the Chriſtians became at length ſo terrible to the Moors, that it is probable they could not long have kept their footing in Spain, had not a great general, named *Mohammed Ebn Amir Almanzor*, appeared, in 979, to ſupport their ſinking cauſe. This man was viſir to the king of Cordova, and being exceedingly provoked againſt the Chriſtians on account of what his countrymen had ſuffered from them, made war with the moſt implacable fury. He took the city of Leon, murdered the inhabitants, and reduced the houſes to aſhes. Barcelona ſhared the ſame fate; Caſtile was reduced to a deſert; Galicia and Portugal ravaged; and he is ſaid to have overcome the Chriſtians in fifty different engagements. At laſt, having taken and demoliſhed the city of Compoſtella, and carried off in triumph the gates of the church of St James, a flux happened to break out among his troops, which the ſuperſtitious Chriſtians ſuppoſed to be a divine judgement on account of his ſacrilege. Taking it for granted, therefore, that the Moors were now entirely deſtitute of all heavenly aid, they fell upon them with

36 Exploits of Almanzor a Saracen general.

Spain.

such fury in the next engagement, that all the valour and conduct of Almanzor could not prevent a defeat. Overcome with shame and despair at this misfortune, he desired his followers to shift for themselves, while he himself retired to Medina Cœli, and put an end to his life by abstinence in the year 998.

37 He is defeated, and starves himself to death.

38 History of the kingdom of Castile.

During this period a new Christian principality appeared in Spain, namely that of Castile, which is now divided into the Old and New Castile. The Old Castile was recovered long before that called the *New*. It was separated from the kingdom of Leon on one side by some little rivers; on the other, it was bounded by the Asturias, Biscay, and the province of Rioja. On the south it had the mountains of Segovia and Avila; thus lying in the middle between the Christian kingdom of Leon and Oviedo, and the Moorish kingdom of Cordova. Hence this district soon became an object of contention between the kings of Leon and those of Cordova; and as the former were generally victorious, some of the principal Castilian nobility retained their independency under the protection of the Christian kings, even when the power of the Moors was at its greatest height. In 884 we first hear of Don Rodriguez assuming the title of *count of Castile*, though it does not appear that either his territory or title were given him by the king of Leon. Nevertheless, this monarch having taken upon him to punish some of the Castilian lords as rebels, the inhabitants made a formal renunciation of their allegiance, and set up a new kind of government. The supreme power was now vested in two persons of quality styled *judges*; however, this method did not long continue to give satisfaction, and the sovereignty was once more vested in a single person. By degrees Castile fell entirely under the power of the kings of Leon and Oviedo; and, in 1035, Don Sanchez bestowed it on his eldest son Don Ferdinand, with the title of *king*; and thus the territories of Castile were first firmly united to those of Leon and Oviedo, and the sovereigns were thenceforth styled *kings of Leon and Castile*.

39 History of Arragon.

Besides all these, another Christian kingdom was set up in Spain about the beginning of the 11th century. This was the kingdom of Arragon. The inhabitants were very brave, and lovers of liberty, so that it is probable they had in some degree maintained their independency, even when the power of the Moors was greatest. The history of Arragon, however, during its infancy, is much less known than that of any of the others hitherto mentioned. We are only assured, that about the year 1035, Don Sanchez, surnamed the *Great*, king of Navarre, erected Arragon into a kingdom in favour of his son Don Ramira, and afterwards it became very powerful. At this time, then, we may imagine the continent of Spain divided into two unequal parts by a straight line drawn from east to west, from the coasts of Valentia to a little below the mouth of the Duro. The country north of this belonged to the Christians, who, as yet, had the smallest and least valuable share, and all the rest to the Moors. In point of wealth and real power, both by land and sea, the Moors were greatly superior; but their continual dissensions greatly weakened them, and every day facilitated the progress of the Christians. Indeed, had either of the parties been united, the other must soon have yielded; for though the Christians did not make war upon each other constantly as the Moors did, their mutual feuds were yet sufficient to have ruined them, had their adversaries made the least use of the advantages thus afforded them. But among the Moors almost every city was a kingdom; and as these petty sovereignties supported one another very indifferently, they fell a prey one after another to their enemies. In 1080, the king of Toledo was engaged in a war with the king of Seville, another Moorish potentate; which being observed by Alphonso king of Castile, he also invaded his territories; and in four years made himself master of the city of Toledo, with all the places of importance in its neighbourhood; from thenceforth making Toledo the capital of his dominions. In a short time the whole province of New Castile submitted; and Madrid, the present capital of Spain, fell into the hands of the Christians, being at that time but a small place.

40 State of Spain in the beginning of the 11th century.

41 Toledo and Madrid taken by the Christians.

The Moors were so much alarmed at these conquests, that they not only entered into a general confederacy against the Christians, but invited to their assistance Mahomet Ben Joseph the sovereign of Barbary. He accordingly came, attended by an incredible multitude; but was utterly defeated by the Christians in the defiles of the Black Mountain, or Sierra Morena, on the borders of Andalusia. This victory happened on the 16th of July 1212, and the anniversary is still celebrated at Toledo. This victory was not improved; the Christian army immediately dispersed themselves, while the Moors of Andalusia were strengthened by the remains of the African army; yet, instead of being taught, by their past misfortunes, to unite among themselves, their dissensions became worse than ever, and the conquests of the Christians became daily more rapid. In 1236, Don Ferdinand of Castile and Leon took the celebrated city of Cordova, the residence of the first Moorish kings; at the same time that James I. of Arragon dispossessed them of the island of Majorca, and drove them out of Valentia. Two years after, Ferdinand made himself master of Murcia, and took the city of Seville; and in 1303 Ferdinand IV. reduced Gibraltar.

42 A signal victory gained over the Moors.

43 Eng and interferes in the Spanish affairs.

In the time of Edward III. we find England, for the first time, interfering in the affairs of Spain, on the following occasion. In the year 1284 the kingdom of Navarre had been united to that of France by the marriage of Donna Joanna queen of Navarre with Philip the Fair of France. In 1328, however, the kingdoms were again separated, though the sovereigns of Navarre were still related to those of France. In 1350, Charles, surnamed the *Wicked*, ascended the throne of Navarre, and married the daughter of John king of France. Notwithstanding this alliance, and that he himself was related to the royal family of France, he secretly entered into a negociation with England against the French monarch, and even drew into his schemes the dauphin Charles, afterwards surnamed *the Wise*. The young prince, however, was soon after made fully sensible of the danger and folly of the connections into which he had entered; and, by way of atonement, promised to sacrifice his associates. Accordingly he invited the king of Navarre, and some of the principal nobility of the same party, to a feast at Rouen, where he betrayed them to his father. The most obnoxious were executed, and the king of Navarre was thrown into prison. In this extremity, the party of the king of Navarre had recourse to England. The prince of Wales, surnamed

44 The king of Navarre imprisoned by John king of France.

Spain.

† See *France* n° 44.

the Black Prince, invaded France, defeated king John at Poictiers, and took him priſoner†; which unfortunate event produced the moſt violent diſturbances in that kingdom. The dauphin, now about 19 years of age, naturally aſſumed the royal power during his father's captivity: but poſſeſſed neither experience nor authority ſufficient to remedy the prevailing evils. In order to obtain ſupplies, he aſſembled the ſtates of the kingdom: but that aſſembly, inſtead of ſupporting his adminiſtration, laid hold of the preſent opportunity to demand limitations of the prince's power, the puniſhment of paſt malverſations, and the liberty of the king of Navarre. Marcel, provoſt of the merchants of Paris, and firſt magiſtrate of that city, put himſelf at the head of the unruly populace, and puſhed them to commit the moſt criminal outrages againſt the royal authority. They detained the dauphin in a kind of captivity, murdered in his preſence Robert de Clermont and John de Conflans, mareſchals of France; threatened all the other miniſters with the like fate; and when Charles, who had been obliged to temporize and diſſemble, made his eſcape from their hands, they levied war againſt him, and openly rebelled. The other cities of the kingdom, in imitation of the capital, ſhook off the dauphin's authority, took the government into their own hands, and ſpread the contagion into every province.

45 Eſcapes, and heads the French malecontents.

Amidſt theſe diſorders, the king of Navarre made his eſcape from priſon, and preſented a dangerous leader to the furious malecontents. He revived his pretenſions to the crown of France: but in all his operations he acted more like a leader of banditti than one who aſpired to be the head of a regular government, and who was engaged by his ſtation to endeavour the re-eſtabliſhment of order in the community. All the French, therefore, who wiſhed to reſtore peace to their country, turned their eyes towards the dauphin; who, though not remarkable for his military talents, daily gained by his prudence and vigilance the aſcendant over his enemies. Marcel, the ſeditious provoſt of Paris, was ſlain in attempting to deliver that city to the king of Navarre. The capital immediately returned to its duty: the moſt conſiderable bodies of the mutinous peaſants were diſperſed or put to the ſword; ſome bands of military robbers underwent the ſame fate; and France began once more to aſſume the appearance of civil government.

John was ſucceeded in the throne of France by his ſon Charles V. a prince educated in the ſchool of adverſity, and well qualified, by his prudence and experience, to repair the loſſes which the kingdom had ſuſtained from the errors of his predeceſſors. Contrary to the practice of all the great princes of thoſe times, who held nothing in eſtimation but military courage, he ſeems to have laid it down as a maxim, never to appear at the head of his armies; and he was the firſt European monarch that ſhowed the advantage of policy and foreſight over a raſh and precipitate valour.

Before Charles could think of counterbalancing ſo great a power as England, it was neceſſary for him to remedy the many diſorders to which his own kingdom was expoſed. He accordingly turned his arms againſt the king of Navarre, the great diſturber of France during that age; and he defeated that prince, and reduced him to terms, by the valour and conduct of Bertrand du Gueſclin, one of the moſt accompliſhed captains of thoſe times, whom Charles had the diſcernment to chooſe as the inſtrument of his victories. He alſo ſettled the affairs of Brittany, by acknowledging the title of Mountfort, and receiving homage for his dominions. But much was yet to be done. On the concluſion of the peace of Bretigni, the many military adventurers who had followed the fortunes of Edward, being diſperſed into the ſeveral provinces, and poſſeſſed of ſtrongholds, refuſed to lay down their arms, or relinquiſh a courſe of life to which they were now accuſtomed, and by which alone they could earn a ſubſiſtence. They aſſociated themſelves with the banditti, who were already inured to the habits of rapine and violence; and, under the name of *companies* and *companions*, became a terror to all the peaceable inhabitants. Some Engliſh and Gaſcon gentlemen of character were not aſhamed to take the command of theſe ruffians, whoſe number amounted to near 40,000, and who bore the appearance of regular armies rather than bands of robbers. As Charles was not able by power to redreſs ſo enormous a grievance, he was led by neceſſity, as well as by the turn of his character, to correct it by policy; to diſcover ſome method of diſcharging into foreign countries this dangerous and inteſtine evil; and an occaſion now offered.

Spain.

47 Account of the banditti called *companies* or *companions*.

48 Reign of Peter the Cruel, king of Caſtile.

Alphonſo XI. king of Caſtile, who took the city of Algezira from the Moors, after a famous ſiege of two years, during which artillery are ſaid firſt to have been uſed by the beſieged, had been ſucceeded by his ſon Peter I. ſurnamed *the Cruel*; a prince equally perfidious, debauched, and bloody. He began his reign with the murder of his father's miſtreſs Leonora de Guſman: his nobles fell every day the victims of his ſeverity: he put to death his couſin and one of his natural brothers, from groundleſs jealouſy; and he cauſed his queen Blanche de Bourbon, of the blood of France, to be thrown into priſon, and afterwards poiſoned, that he might enjoy in quiet the embraces of Mary de Padella, with whom he was violently enamoured.

Henry count of Traſtamara, the king's natural brother, alarmed at the fate of his family, and dreading his own, took arms againſt the tyrant; but having failed in the attempt, he fled to France, where he found the minds of men much inflamed againſt Peter, on account of the murder of the French princeſs. He aſked permiſſion of Charles to enliſt the *companies* in his ſervice, and to lead them into Caſtile againſt his brother. The French king, charmed with the project, employed du Gueſclin in negociating with the leaders of theſe banditti. The treaty was ſoon concluded; and du Gueſclin having completed his levies, led the army firſt to Avignon, where the Pope then reſided, and demanded, ſword in hand, abſolution for his ruffian ſoldiers, who had been excommunicated, and the ſum of 200,000 livres for their ſubſiſtence. The firſt was readily promiſed him; but ſome difficulty being made with regard to the ſecond, du Gueſclin replied, "My fellows, I believe, may make a ſhift to do without your abſolution, but the money is abſolutely neceſſary." His Holineſs then extorted from the inhabitants of the city and its neighbourhood the ſum of 100,000 livres, and offered it to du Gueſclin. "It is not my purpoſe (cried that generous warrior) to oppreſs the innocent people." The pope and his cardinals can ſpare me double the ſum from their own pockets. I therefore inſiſt, that

49 The Companies employed againſt him.

46 Is defeated and obliged to ſubmit to the terms preſcribed by Char. V of France.

Spain.

this money be reſtored to the owners; and if I hear they are defrauded of it, I will myſelf return from the other ſide of the Pyrenees, and oblige you to make them reſtitution." The pope found the neceſſity of ſubmitting, and paid from his own treaſury the ſum demanded.

50 He is driven out, but aſſiſted by the Black Prince.

A body of experienced and hardy ſoldiers, conducted by ſo able a general, eaſily prevailed over the king of Caſtile, whoſe ſubjects were ready to join the enemy againſt their oppreſſor. Peter fled from his dominions, took ſhelter in Guienne, and craved the protection of the prince of Wales, whom his father had inveſted with the ſovereignty of the ceded provinces, under the title of the *principality of Aquitaine*. The prince promiſed his aſſiſtance to the dethroned monarch; and having obtained his father's conſent, he levied an army, and ſet out on his enterpriſe.

The firſt loſs which Henry of Traſtamara ſuffered from the interpoſition of the prince of Wales, was the recalling of the companies from his ſervice; and ſo much reverence did they pay to the name of Edward, that great numbers of them immediately withdrew from Spain, and inliſted under his ſtandard. Henry, however, beloved by his new ſubjects, and ſupported by the king of Arragon, was able to meet the enemy with an army of 100,000 men, three times the number of thoſe commanded by the Black Prince: yet du Gueſclin, and all his experienced officers, adviſed him to delay a deciſive action; ſo high was their opinion of the valour and conduct of the Engliſh hero! But Henry, truſting to his numbers, ventured to give Edward battle on the banks of the Ebro, between Najara and Navarette; where the French and Spaniards were defeated, with the loſs of above 20,000 men, and du Gueſclin and other officers of diſtinction taken priſoners. All Caſtile ſubmitted to the victor; Peter was reſtored to the throne, and Edward returned to Guienne with his uſual glory; having not only overcome the greateſt general of his age, but reſtrained the moſt blood-thirſty tyrant from executing vengeance on his priſoners.

51 The Spaniards defeated and Peter reſtored.

This gallant warrior had ſoon reaſon to repent of his connections with a man like Peter, loſt to all ſenſe of virtue and honour. The ungrateful monſter refuſed the ſtipulated pay to the Engliſh forces. Edward abandoned him; he treated his ſubjects with the utmoſt barbarity; their animoſity was rouſed againſt him; and du Gueſclin having obtained his ranſom, returned to Caſtile with the count of Traſtamara, and ſome forces levied anew in France. They were joined by the Spaniſh malecontents; and having no longer the Black Prince to encounter, they gained a complete victory over Peter in the neighbourhood of Toledo. The tyrant now took refuge in a caſtle, where he was ſoon after beſieged by the victors, and taken priſoner in endeavouring to make his eſcape. He was conducted to his brother Henry; againſt whom he is ſaid to have ruſhed in a tranſport of rage, diſarmed as he was. Henry ſlew him with his own hand, in reſentment of his cruelties; and, though a baſtard, was placed on the throne of Caſtile, which he tranſmitted to his poſterity.

52 Is again driven out, defeated, and put to death.

After the death of Peter the Cruel, nothing remarkable happened in Spain for almoſt a whole century; but the debaucheries of Henry IV. of Caſtile rouſed the reſentment of his nobles, and produced a moſt ſingular inſurrection, which led to the aggrandizement of the Spaniſh monarchy. Spain.

53 Reign of Henry the Impotent.

This prince, ſurnamed the *Impotent*, though continually ſurrounded with women, began his unhappy reign in 1454. He was totally enervated by his pleaſures; and every thing in his court conſpired to ſet the Caſtilians an example of the moſt abject flattery and moſt abandoned licentiouſneſs. The queen, a daughter of Portugal, lived as openly with her paraſites and her gallants as the king did with his minions and his miſtreſſes. Pleaſure was the only object, and effeminacy the only recommendation to favour: the affairs of the ſtate went every day into diſorder; till the nobility, with the archbiſhop of Toledo at their head, combining againſt the weak and flagitious adminiſtration of Henry, arrogated to themſelves, as one of the privileges of their order, the right of trying and paſſing ſentence on their ſovereign, which they executed in a manner unprecedented in hiſtory.

54 He is formally depoſed.

All the malecontent nobility were ſummoned to meet at Avila: a ſpacious theatre was erected in a plain without the walls of the town: an image, repreſenting the king, was ſeated on a throne, clad in royal robes, with a crown on its head, a ſceptre in its hand, and the ſword of juſtice by its ſide. The accuſation againſt Henry was read, and the ſentence of depoſition pronounced, in preſence of a numerous aſſembly. At the cloſe of the firſt article of the charge, the archbiſhop of Toledo advanced, and tore the crown from the head of the image; at the cloſe of the ſecond, the Conde de Placentia ſnatched the ſword of juſtice from its ſide; at the cloſe of the third, the Conde de Benavente wreſted the ſceptre from its hand; and at the cloſe of the laſt, Don Diego Lopez de Stuniga tumbled it headlong from the throne. At the ſame inſtant, Don Alphonſo, Henry's brother, a boy of about twelve years of age, was proclaimed king of Caſtile and Leon in his ſtead.

This extraordinary proceeding was followed by a civil war, which did not ceaſe till ſome time after the death of the young prince, on whom the nobles had beſtowed the kingdom. The archbiſhop and his party then continued to carry on war in the name of Iſabella the king's ſiſter, to whom they gave the title of *Infanta*; and Henry could not extricate himſelf out of theſe troubles, nor remain quiet upon his throne till he had ſigned one of the moſt humiliating treaties ever extorted from a ſovereign; he acknowledged his ſiſter Iſabella the only lawful heireſs of his kingdom, in prejudice to the rights of his reputed daughter Joan, whom the malecontents affirmed to be the offspring of an adulterous commerce between the queen and Don la Cueva. The grand object of the malecontent party now was the marriage of the princeſs Iſabella, upon which, it was evident, the ſecurity of the crown and the happineſs of the people muſt in a great meaſure depend. The alliance was ſought by ſeveral princes: the king of Portugal offered her his hand; the king of France demanded her for his brother, and the king of Arragon for his ſon Ferdinand. The malecontents very wiſely preferred the Arragonian prince, and Iſabella prudently made the ſame choice: articles were drawn up; and they were privately married by the archbiſhop of Toledo.

55 Is obliged to acknowledge his ſiſter Iſabella to be heireſs to the kingdom.

56 She is married to Ferdinand of Arragon.

Spain.

Henry was enraged at this alliance, which he foreſaw would utterly ruin his authority, by furniſhing his rebellious ſubjects with the ſupport of a powerful neighbouring prince. He diſinherited his ſiſter, and eſtabliſhed the rights of his daughter. A furious civil war deſolated the kingdom. The names of Joan and Iſabella reſounded from every quarter, and were everywhere the ſummons to arms. But peace was at length brought about. Henry was reconciled to his ſiſter and Ferdinand; though it does not appear that he ever renewed Iſabella's right to the ſucceſſion: for he affirmed in his laſt moments, that he believed Joan to be his own daughter. The queen ſwore to the ſame effect; and Henry left a teſtamentary deed, tranſmitting the crown to this princeſs, who was proclaimed queen of Caſtile at Placentia. But the ſuperior fortune and ſuperior arms of Ferdinand and Iſabella prevailed: the king of Portugal was obliged to abandon his niece and intended bride, after many ineffectual ſtruggles, and ſeveral years of war. Joan retired into a convent; and the death of Ferdinand's father, which happened about this time, added the kingdoms of Arragon and Sicily to thoſe of Leon and Caſtile.

57 Union of the kingdoms of Arragon and Sicily with Leon and Caſtile.

Ferdinand and Iſabella were perſons of great prudence, and, as ſovereigns, highly worthy of imitation: but they do not ſeem to have merited all the praiſes beſtowed upon them by the Spaniſh hiſtorians. They did not live like man and wife, having all things in common under the direction of the huſband; but like two princes in cloſe alliance; they neither loved nor hated each other; were ſeldom in company together; had each a ſeparate council; and were frequently jealous of one another in the adminiſtration. But they were inſeparably united in their common intereſts; always acting upon the ſame principles, and forwarding the ſame ends. Their firſt object was the regulation of their government, which the civil wars had thrown into the greateſt diſorder. Rapine, outrage, and murder, were become ſo common, as not only to interrupt commerce, but in a great meaſure to ſuſpend all intercourſe between one place and another. Theſe evils the joint ſovereigns ſuppreſſed by their wiſe policy, at the ſame time that they extended the royal prerogative.

58 Adminiſtration of Ferdinand and Iſabella.

About the middle of the 13th century, the cities in the kingdom of Arragon, and after their example thoſe in Caſtile, had formed themſelves into an aſſociation, diſtinguiſhed by the name of the *Holy Brotherhood*. They exacted a certain contribution from each of the aſſociated towns; they levied a conſiderable body of troops, in order to protect travellers and purſue criminals; and they appointed judges, who opened courts in various parts of the kingdom. Whoever was guilty of murder, robbery, or any act that violated the public peace, and was ſeized by the troops of the Brotherhood, was carried before their judges; who, without paying any regard to the excluſive juriſdiction which the lord of the place might claim, who was generally the author or abettor of the injuſtice, tried and condemned the criminals. The nobles often murmured againſt this ſalutary inſtitution; they complained of it as an encroachment on one of their moſt valuable privileges, and endeavoured to get it aboliſhed. But Ferdinand and Iſabella, ſenſible of the beneficial effects of the Brotherhood, not only in regard to the police of their kingdom, but in its tendency to abridge, and by degrees annihilate, the territorial juriſdiction of the nobility, countenanced the inſtitution upon every occaſion, and ſupported it with the whole force of royal authority; by which means the prompt and impartial adminiſtration of juſtice was reſtored, and with it tranquillity and order returned.

59 Inſtitution of the Holy Brotherhood.

Spain.

But at the ſame time that their Catholic majeſties (for ſuch was the title they now bore) were giving vigour to their civil government, and ſecuring their ſubjects from violence and oppreſſion, an intemperate zeal led them to eſtabliſh an eccleſiaſtical tribunal, equally contrary to the natural rights of humanity and the mild ſpirit of the goſpel. This was the court of inquiſition; which decides upon the honour, fortune, and even the life, of the unhappy wretch who happens to fall under the ſuſpicion of hereſy, or a contempt of any thing preſcribed by the church, without his knowing, being confronted with his accuſers, or permitted either defence or appeal. Six thouſand perſons were burnt by order of this ſanguinary tribunal within four years after the appointment of Torquemada, the firſt inquiſitor-general; and upwards of 100,000 felt its fury. The ſame furious and blinded zeal which led to the depopulation of Spain, led alſo to its aggrandizement.

60 And of the Inquiſition.

61 Conqueſt of Granada.

The kingdom of Granada now alone remained of all the Mahometan poſſeſſions in Spain. Princes equally zealous and ambitious were naturally diſpoſed to turn their eyes to that fertile territory, and to think of increaſing their hereditary dominions, by expelling the enemies of Chriſtianity, and extending its doctrines. Every thing conſpired to favour their project: the Mooriſh kingdom was a prey to civil wars; when Ferdinand, having obtained the bull of Sixtus IV. authorizing a cruſade, put himſelf at the head of his troops, and entered Granada. He continued the war with rapid ſucceſs: Iſabella attended him in ſeveral expeditions; and they were both in great danger at the ſiege of Malaga; an important city, which was defended with great courage, and taken in 1487. Baza was reduced in 1489, after the loſs of 20,000 men. Guadix and Almeria were delivered up to them by the Mooriſh king Alzagel, who had firſt dethroned his brother Alboacen, and afterwards been chaſed from his capital by his nephew Abdali. That prince engaged in the ſervice of Ferdinand and Iſabella; who, after reducing every other place of eminence, undertook the ſiege of Granada. Abdali made a gallant defence; but all communication with the country being cut off, and all hopes of relief at an end, he capitulated, after a ſiege of eight months, on condition that he ſhould enjoy the revenue of certain places in the fertile mountains of Alpujarros; that the inhabitants ſhould retain the undiſturbed poſſeſſion of their houſes, goods, and inheritances; the uſe of their laws, and the free exerciſe of their religion. Thus ended the empire of the Arabs in Spain, after it had continued about 800 years. They introduced the arts and ſciences into Europe at a time when it was loſt in darkneſs; they poſſeſſed many of the luxuries of life, when they were not even known among the neighbouring nations; and they ſeem to have given birth to that romantic gallantry which ſo eminently prevailed in the ages of chivalry, and which, blending itſelf with the veneration of the northern nations for the ſofter ſex, ſtill particularly diſtinguiſhes ancient from modern manners.

Spain.

ners. But the Moors, notwithstanding these advantages, and the eulogies bestowed upon them by some writers, appear always to have been destitute of the essential qualities of a polished people, humanity, generosity, and mutual sympathy.

62 Jews expelled from Spain.

The conquest of Granada was followed by the expulsion, or rather the pillage and banishment, of the Jews, who had engrossed all the wealth and commerce of Spain. The inquisition exhausted its rage against these unhappy people, many of whom pretended to embrace Christianity, in order to preserve their property. About the same time their Catholic majesties concluded an alliance with the emperor Maximilian, and a treaty of marriage for their daughter Joan with his son Philip, archduke of Austria and sovereign of the Netherlands. About this time also the contract was concluded with Christopher Columbus for the discovery of new countries; and the counties of Rousillon and Cerdagne were agreed to be restored by Charles VIII. of France, before his expedition into Italy. The discovery of America was soon followed by extensive conquests in that quarter, as is related under the articles MEXICO, PERU, CHILI, &c. which tended to raise the Spanish monarchy above any other in Europe.

63 Discovery of America, &c.

64 Accession of Charles V.

On the death of Isabella, which happened in 1506, Philip archduke of Austria came to Castile in order to take possession of that kingdom as heir to his mother-in-law; but he dying in a short time after, his son Charles V. afterwards emperor of Germany, became heir to the crown of Spain. His father at his death left the king of France governor to the young prince, and Ferdinand at his death left cardinal Ximenes sole regent of Castile, till the arrival of his grandson. This man, whose character is no less singular than illustrious, who united the abilities of a great statesman with the abject devotion of a superstitious monk, and the magnificence of a prime minister with the severity of a mendicant, maintained order and tranquillity in Spain, notwithstanding the discontents of a turbulent and high-spirited nobility. When they disputed his right to the regency, he coolly showed them the testament of Ferdinand, and the ratification of that deed by Charles; but these not satisfying them, and argument proving ineffectual, he led them insensibly towards a balcony, whence they had a view of a large body of troops under arms, and a formidable train of artillery. "Behold (said the cardinal) the powers which I have received from his Catholic majesty: by these I govern Castile; and will govern it, till the king, your master and mine, shall come to take possession of his kingdom." A declaration so bold and determined silenced all opposition; and Ximenes maintained his authority till the arrival of Charles in 1517.

65 Disgrace and death of cardinal Ximenes.

The young king was received with universal acclamations of joy; but Ximenes found little cause to rejoice. He was seized with a violent disorder, supposed to be the effect of poison; and when he recovered, Charles, prejudiced against him by the Spanish grandees and his Flemish courtiers, slighted his advice, and allowed him every day to sink into neglect. The cardinal did not bear this treatment with his usual fortitude of spirit. He expected a more grateful return from a prince to whom he delivered a kingdom more flourishing than it had been in any former age, and authority more extensive and better established than the most illustrious of his ancestors had ever possessed. Conscious of his own integrity and merit, he could not therefore refrain from giving vent, at times, to indignation and complaint. He lamented the fate of his country, and foretold the calamities to which it would be exposed from the insolence, the rapaciousness, and the ignorance of strangers. But in the mean time he received a letter from the king, dismissing him from his councils, under pretence of easing his age of that burden which he had so long and so ably sustained. This letter proved fatal to the minister; for he expired in a few hours after reading it.

Spain.

66 Maximilian attempts to get Charles elected emperor.

While Charles was taking possession of the throne of Spain, in consequence of the death of one grandfather, another was endeavouring to obtain for him the imperial crown. With this view Maximilian assembled a diet at Augsburg, where he cultivated the favour of the electors by many acts of beneficence, in order to engage them to choose that young prince as his successor. But Maximilian himself never having been crowned by the pope, a ceremony deemed essential in that age, as well as in the preceding, he was considered only as king of the Romans, or emperor elect; and no example occurring in history of any person being chosen successor to a king of the Romans, the Germans, always tenacious of their forms, obstinately refused to confer upon Charles a dignity for which their constitution knew no name.

But though Maximilian could not prevail upon the German electors to choose his grandson of Spain king of the Romans, he had disposed their minds in favour of that prince; and other circumstances, on the death of the emperor, conspired to the exaltation of Charles. The imperial crown had so long continued in the Austrian line, that it began to be considered as hereditary in that family; and Germany, torn by religious disputes, stood in need of a powerful emperor, not only to preserve its own internal tranquillity, but also to protect it against the victorious arms of the Turks, who under Selim I. threatened the liberties of Europe. This fierce and rapid conqueror had already subdued the Mamalukes, and made himself master of Egypt and Syria. The power of Charles appeared necessary to oppose that of Selim. The extensive dominions of the house of Austria, which gave him an interest in the preservation of Germany; the rich sovereignty of the Netherlands and Franche Compte; the entire possession of the great and warlike kingdom of Spain, together with that of Naples and Sicily, all united to hold him up to the first dignity among Christian princes; and the new world seemed only to be called into existence that its treasures might enable him to defend Christendom against the infidels. Such was the language of his partisans.

67 Francis I. aspires to the same dignity.

Francis I. however, no sooner received intelligence of the death of Maximilian, than he declared himself a candidate for the empire; and with no less confidence of success than Charles. He trusted to his superior years and experience; his great reputation in arms; and it was farther urged in his favour, that the impetuosity of the French cavalry, added to the firmness of the German infantry, would prove irresistible, and not only be sufficient, under a warlike emperor, to set limits to the ambition of Selim, but to break entirely the Ottoman power, and prevent it from ever becoming dangerous again to Germany.

Both claims were plausible. The dominions of Fran-

Spain.

cis were leſs extenſive, but more united than thoſe of Charles. His ſubjects were numerous, active, brave, lovers of glory, and lovers of their king. Theſe were ſtrong arguments in favour of his power, ſo neceſſary at this juncture: but he had no natural intereſt in the Germanic body; and the electors, hearing ſo much of military force on each ſide, became more alarmed for their own privileges than the common ſafety. They determined to reject both candidates, and offered the imperial crown to Frederic, ſurnamed the *Wiſe*, duke of Saxony. But he, undazzled by the ſplendour of an object courted with ſo much eagerneſs by two mighty monarchs, rejected it with a magnanimity no leſs ſingular than great.

68 Speech of Frederic duke of Saxony in favour of Charles.

"In times of tranquillity (ſaid Frederic), we wiſh for an emperor who has no power to invade our liberties; times of danger demand one who is able to ſecure our ſafety. The Turkiſh armies, led by a warlike and victorious monarch, are now aſſembling: they are ready to pour in upon Germany with a violence unknown in former ages. New conjunctures call for new expedients. The imperial ſceptre muſt be committed to ſome hand more powerful than mine or that of any other German prince. We poſſeſs neither dominions, nor revenues, nor authority, which enable us to encounter ſuch a formidable enemy. Recourſe muſt be had, in this exigency, to one of the rival monarchs. Each of them can bring into the field forces ſufficient for our defence. But as the king of Spain is of German extraction, as he is a member and prince of the empire by the territories which deſcend to him from his grandfather, and as his dominions ſtretch along that frontier which lies moſt expoſed to the enemy, his claim, in my opinion, is

69 He is elected in conſequence of this ſpeech.

preferable to that of a ſtranger to our language, to our blood, and to our country." Charles was elected in conſequence of this ſpeech in the year 1520.

The two candidates had hitherto conducted their rivalſhip with emulation, but without enmity. They had even mingled in their competition many expreſſions of friendſhip and regard. Francis in particular declared with his uſual vivacity, that his brother Charles and he were fairly and openly ſuitors to the ſame miſtreſs: "The moſt aſſiduous and fortunate (added he) will win her; and the other muſt reſt contented." But the preference was no ſooner given to his rival, than Francis diſcovered all the paſſions natural to diſappointed ambition. He could not ſuppreſs his chagrin and indignation at being baulked in his favourite purſuit, and rejected, in the face of all Europe, for a youth yet unknown to fame. The ſpirit of Charles reſented ſuch

70 A mutual hatred takes place between Charles and Francis.

contempt; and from this jealouſy, as much as from oppoſition of intereſts, aroſe that emulation between thoſe two great monarchs which involved them in almoſt perpetual hoſtilities, and kept their whole age in movement.

Charles and Francis had many interfering claims in Italy; and the latter thought himſelf bound in honour to reſtore the king of Navarre to his dominions, unjuſtly ſeized by the crown of Spain. They immediately began to negotiate; and as Henry VIII. of England was the third prince of the age in power and in dignity, his friendſhip was eagerly courted by each of the rivals. He was the natural guardian of the liberties of Europe. Senſible of the conſequence which his ſituation gave him, and proud of his pre-eminence, Henry knew it to

71 Both court the friendſhip of Henry VIII. of England.

be his intereſt to keep the balance even between the contending powers, and to reſtrain both, by not joining entirely with either; but he was ſeldom able to reduce his ideas to practice. Vanity and reſentment were the great ſprings of all his undertakings; and his neighbours, by touching theſe, found an eaſy way to draw him into their meaſures, and force him upon many raſh and inconſiderate enterpriſes.

All the impolitic ſteps in Henry's government muſt not, however, be imputed to himſelf; many of them were occaſioned by the ambition and avarice of his prime miniſter and favourite cardinal Wolſey. This man, who, by his talents and accompliſhments, had riſen from one of the loweſt conditions in life to the higheſt employments both in church and ſtate, enjoyed a greater degree of power and dignity than any Engliſh ſubject ever poſſeſſed, and governed the haughty, preſumptuous, and untractable ſpirit of Henry, with abſolute authority. Francis was equally well acquainted with the character of Henry and of his miniſter. He had ſucceſsfully flattered Wolſey's pride, by honouring him with particular marks of his confidence, and beſtowing upon him the appellation of *Father*, *Tutor*, and *Governor*; and he had obtained the reſtitution of Tournay, by adding a penſion to thoſe reſpectful titles. He now ſolicited an interview with the king of England near Calais; in hopes of being able, by familiar converſation, to attach him to his friendſhip and intereſt, while he gratified the cardinal's vanity, by affording him an opportunity of diſplaying his magnificence in the preſence of two courts, and of diſcovering to the two nations his influence over their monarchs. Charles dreaded the effects of this projected interview between two gallant princes, whoſe hearts were no leſs ſuſceptible of friendſhip than their manners were of inſpiring it. Finding it impoſſible, however, to prevent a viſit, in which the vanity of all parties was ſo much concerned, he endeavoured to defeat its purpoſe, and to pre-occupy the favour of the Engliſh monarch, and of his miniſter, by an act of complaiſance ſtill more flattering and more uncommon. Relying wholly upon Henry's generoſity for his ſafety, he landed at Dover, in his way from Spain to the Low Countries. The king of England, who was on his way to France, charmed with ſuch an inſtance of confidence, haſtened to receive his royal gueſt; and Charles, during his ſhort ſtay, had the addreſs not only to give Henry favourable impreſſions of his character and intentions, but to detach Wolſey entirely from the intereſt of Francis. The tiara had attracted the eye of that ambitious prelate; and as the emperor knew that the papacy was the ſole point of elevation, beyond his preſent greatneſs, at which he could aſpire, he made him an offer of his intereſt on the firſt vacancy.

72 An interview projected between Francis and Henry.

73 Charles viſits Henry in England.

74 Henry viſits Francis in France.

The day of Charles's departure, Henry went over to Calais with his whole court, in order to meet Francis. Their interview was in an open plain between Guiſnes and Ardres; where the two kings and their attendants diſplayed their magnificence with ſuch emulation and profuſe expence, as procured it the name of the *Field of the Cloth of Gold*. Here Henry erected a ſpacious houſe of wood and canvas, framed in London, on which, under the figure of an Engliſh archer, was the following motto: "He prevails whom I favour;" alluding to his own political ſituation, as holding in his hands

Spain. hands the balance of power among the potentates of Europe. Feats of chivalry however, parties of gallantry, and ſuch exerciſes as were in that age reckoned manly or elegant, rather than ſerious buſineſs, occupied the two courts during the time that they continued together, which was 18 days.

After taking leave of this ſcene of diſſipation, the king of England paid a viſit to the emperor and Margaret of Savoy at Gravelines, and engaged them to go along with him to Calais; where the artful and politic Charles completed the impreſſion which he had begun to make on Henry and his favourite, and effaced all the friendſhip to which the frank and generous nature of Francis had given birth. He renewed his aſſurances of aſſiſting Wolſey in obtaining the papacy; and he put him in preſent poſſeſſion of the revenues belonging to the ſees of Badajox and Palencia in Spain. He flattered Henry's pride, by convincing him of his own importance, and of the juſtneſs of the motto which he had choſen; offering to ſubmit to his ſole arbitration any difference that might ariſe between him and Francis.

75 Charles inveſted with the imperial crown at Aix-la-Chapelle.

This important point being ſecured, Charles repaired to Aix-la-Chapelle, where he was ſolemnly inveſted with the crown and ſceptre of Charlemagne, in preſence of a more ſplendid and numerous aſſembly than had appeared on any former inauguration. About the ſame time Solyman the Magnificent, one of the moſt accompliſhed, enterpriſing, and victorious of the Turkiſh princes, and a conſtant and formidable rival to the emperor, aſcended the Ottoman throne.

The firſt act of Charles's adminiſtration was to appoint a diet of the empire, to be held at Worms, in order to concert with the princes proper meaſures for checking the progreſs of "thoſe new and dangerous opinions which threatened to diſturb the peace of Germany, and to overturn the religion of their anceſtors." The opinions propagated by Luther and his followers were here meant. But all his efforts for that purpoſe were inſufficient, as is related under the articles LUTHER and REFORMATION,

76 War between Francis and Charles.

In 1521, the Spaniards, diſſatisfied with the departure of their ſovereign, whoſe election to the empire they foreſaw would interfere with the adminiſtration of his own kingdom, and incenſed at the avarice of the Flemings, to whom the direction of public affairs had been committed ſince the death of cardinal Ximenes, ſeveral grandees, in order to ſhake off this oppreſſion, entered into an aſſociation, to which they gave the name of the *Santta Juncta*; and the ſword was appealed to as the means of redreſs. This ſeemed to Francis a favourable juncture for reinſtating the family of John d'Albert in the kingdom of Navarre. Charles was at a diſtance from that part of his dominions, and the troops uſually ſtationed there had been called away to quell the commotions in Spain. A French army, under Andrew de Foix, ſpeedily conquered Navarre; but that young and inexperienced nobleman, puſhed on by military ardour, ventured to enter Caſtile. The Spaniards, though divided among themſelves, united againſt a foreign enemy, routed his forces, took him priſoner, and recovered Navarre in a ſhorter time than he had ſpent in ſubduing it.

Hoſtilities thus begun in one quarter, between the rival monarchs, ſoon ſpread to another. The king of France encouraged the duke of Bouillon to make war againſt the emperor, and to invade Luxembourg. Charles, after humbling the duke, attempted to enter France; but was repelled and worſted before Mezieres by the famous chevalier Bayard, diſtinguiſhed among his cotemporaries by the appellation of *The Knight without fear and without reproach*; and who united the talents of a great general to the punctilious honour and romantic gallantry of the heroes of chivalry. Francis broke into the Low Countries, where, by an exceſs of caution, an error not natural to him, he loſt an opportunity of cutting off the whole imperial army; and, what was of ſtill more conſequence, he diſguſted the conſtable Bourbon, by giving the command of the van to the duke of Alençon.

During theſe operations in the field, an unſucceſsful congreſs was held at Calais, under the mediation of Henry VIII. It ſerved only to exaſperate the parties which it was intended to reconcile. A league was ſoon after concluded, by the intrigues of Wolſey, between the pope, Henry, and Charles, againſt France. Leo had already entered into a ſeparate league with the emperor, and the French were faſt loſing ground in Italy.

The inſolence and exactions of Mareſhal de Lautrec, governor of Milan, had totally alienated the affections of the Milaneſe from France. They reſolved to expel the troops of that nation, and put themſelves under the government of Francis Sforza, brother to Maximilian their late duke. In this reſolution, they were encouraged by the pope, who excommunicated Lautrec, and took into his pay a conſiderable body of Swiſs. The papal army, commanded by Proſper Colonna, an experienced general, was joined by ſupplies from Germany and Naples; while Lautrec, neglected by his court, and deſerted by the Swiſs in its pay, was unable to make head againſt the enemy. The city of Milan was betrayed by the inhabitants to the confederates; Parma and Placentia were united to the eccleſiaſtical ſtate; and of their conqueſts in Lombardy, only the town of Cremona, the caſtle of Milan, and a few inconſiderable forts, remained in the hands of the French.

77 Rapid conqueſts of Charles.

Leo X. received the accounts of this rapid ſucceſs with ſuch tranſports of joy, as are ſaid to have brought on a fever, which occaſioned his death. The ſpirit of the confederacy was broken, and its operations ſuſpended by this accident. The Swiſs were recalled; ſome other mercenaries diſbanded for want of pay; and only the Spaniards, and a few Germans in the emperor's ſervice, remained to defend the duchy of Milan. But Lautrec, who with the remnant of his army had taken ſhelter in the Venetian territories, deſtitute both of men and money, was unable to improve this favourable opportunity as he wiſhed. All his efforts were rendered ineffectual by the vigilance and ability of Colonna and his aſſociates.

Meantime much diſcord prevailed in the conclave. Wolſey's name, notwithſtanding all the emperor's magnificent promiſes, was ſcarcely mentioned there. Julio de Medici, Leo's nephew, thought himſelf ſure of the election; when, by an unexpected turn of fortune, cardinal Adrian of Utrecht, Charles's preceptor, who at that time governed Spain in the emperor's name, was unanimouſly raiſed to the papacy, to the aſtoniſhment of all Europe and the great diſguſt of the Italians.

Francis,

Spain.

78 Francis invades Italy.

Francis, roused by the rising consequence of his rival, resolved to exert himself with fresh vigour, in order to wrest from him his late conquests in Lombardy. Lautrec received a supply of money, and a reinforcement of 10,000 Swiss. With this reinforcement he was enabled once more to act offensively, and even to advance within a few miles of the city of Milan; when money again failing him, and the Swiss growing mutinous, he was obliged to attack the imperialists in their camp at Bicocca, where he was repulsed with great slaughter, having lost his bravest officers and best troops. Such of the Swiss as survived set out immediately for their own country; and Lautrec, despairing of being able to keep the field, retired into France. Genoa, which still remained subject to Francis, and made it easy to execute any scheme for the recovery of Milan, was soon after taken by Colonna: the authority of the emperor and his faction was everywhere established in Italy. The citadel of Cremona was the sole fortress which remained in the hands of the French.

The affliction of Francis for such a succession of misfortunes was augmented by the unexpected arrival of an English herald, who in the name of his sovereign declared war against France. The courage of this excellent prince, however, did not forsake him; though his treasury was exhausted by expensive pleasures, no less than by hostile enterprises, he assembled a considerable army, and put his kingdom in a posture of defence for resisting this new enemy, without abandoning any of the schemes which he was forming against the emperor. He was surprised, but not alarmed, at such a denunciation.

79 Charles visits England a second time.

Meanwhile Charles, willing to draw as much advantage as possible from so powerful an ally, paid a second visit to the court of England in his way to Spain, where his presence was become necessary. His success exceeded his most sanguine expectations. He not only gained the entire friendship of Henry, who publicly ratified the treaty of Bruges; but disarmed the resentment of Wolsey, by assuring him of the papacy on Adrian's death; an event seemingly not distant, by reason of his age and infirmities. In consequence of these negociations an English army invaded France, under the command of the earl of Surrey; who, at the end of the campaign, was obliged to retire, with his forces greatly reduced, without being able to make himself master of one place within the French frontier. Charles was more fortunate in Spain: he soon quelled the tumults which had there arisen in his absence.

While the Christian princes were thus wasting each other's strength, Solyman the Magnificent entered Hungary, and made himself master of Belgrade, reckoned the chief barrier of that kingdom against the Turkish power. Encouraged by this success, he turned his victorious arms against the island of Rhodes, at that time the seat of the knights of St John of Jerusalem; and though every prince in that age acknowledged Rhodes to be the great bulwark of Christendom in the east, so violent was their animosity against each other, that they suffered Solyman without disturbance to carry on his operations against that city and island. Lisle Adam, the grandmaster, made a gallant defence; but, after incredible efforts of courage, patience, and military conduct, during a siege of six months, he was obliged to surrender the place, having obtained an honourable capitulation from the sultan, who admired and respected his heroic qualities (see RHODES and MALTA). Charles and Francis were equally ashamed of having occasioned such a loss to Christendom by their contests; and the emperor, by way of reparation, granted to the knights of St John the small island of Malta, where they fixed their residence, and continued long to retain their ancient spirit, though much diminished in power and splendour.

80 Rhodes taken by Solyman.

Spain.

Adrian VI. though the creature of the emperor, and devoted to his interest, endeavoured to assume the impartiality which became the common father of Christendom, and laboured to reconcile the contending princes, that they might unite in a league against Solyman, whose conquest of Rhodes rendered him more formidable than ever to Europe. The Italian states were no less desirous of peace than the pope: and so much regard was paid by the hostile powers to the exhortations of his holiness, and to a bull which he issued, requiring all Christian princes to consent to a truce for three years, that the imperial, the French, and the English ambassadors at Rome, were empowered to treat of that matter; but while they wasted their time in fruitless negociations, their masters were continuing their preparations for war; and other negociations soon took place. The confederacy against France became more formidable than ever.

81 A powerful confederacy against Francis.

The Venetians, who had hitherto adhered to the French interest, formed engagements with the emperor for securing Francis Sforza in the possession of the duchy of Milan; and the pope, from a persuasion that the ambition of the French monarch was the only obstacle to peace, acceded to the same alliance. The Florentines, the dukes of Ferrara and Mantua, and all the Italian powers, followed this example. Francis was left without a single ally, to resist the efforts of a multitude of enemies, whose armies everywhere threatened, and whose territories encompassed his dominions. The emperor in person menaced France with an invasion on the side of Guienne; the forces of England and the Netherlands hovered over Picardy, and a numerous body of Germans was preparing to ravage Burgundy.

The dread of so many and such powerful adversaries, it was thought, would have obliged Francis to keep wholly on the defensive, or at least have prevented him from entertaining any thoughts of marching into Italy. But before his enemies were able to strike a blow, Francis had assembled a great army, with which he hoped to disconcert all the emperor's schemes, by marching it in person into Italy: and this bold measure, the more formidable because unexpected, could scarcely have failed of the desired effect, had it been immediately carried into execution. But the discovery of a domestic conspiracy, which threatened the destruction of his kingdom, obliged Francis to stop short at Lyons.

82 Francis marches towards Italy, but is obliged to return by a domestic conspiracy.

Charles duke of Bourbon, lord high constable of France, was a prince of the most shining merit: his great talents equally fitted him for the council or the field, while his eminent services to the crown intitled him to its first favour. But unhappily Louisa duchess of Angouleme, the king's mother, had contracted a violent aversion against the house of Bourbon, and had taught her son, over whom she had acquired an absolute ascendant, to view all the constable's actions with a jealous eye. After repeated affronts he retired from court,

Spain. and began to liſten to the advances of the emperor's miniſters. Meantime the ducheſs of Bourbon died; and as the conſtable was no leſs amiable than accompliſhed, the ducheſs of Angouleme, ſtill ſuſceptible of the tender paſſions, formed the ſcheme of marrying him. But Bourbon, who might have expected every thing to which an ambitious mind can aſpire, from the doating fondneſs of a woman who governed her ſon and the kingdom, incapable of imitating Louiſa in her ſudden tranſition from hate to love, or of meanly counterfeiting a paſſion for one who had ſo long purſued him with unprovoked malice, rejected the match with diſdain, and turned the propoſal into ridicule. At once deſpiſed and inſulted by the man whom love only could have made her ceaſe to perſecute, Louiſa was filled with all the rage of diſappointed woman; ſhe reſolved to ruin, ſince ſhe could not marry, Bourbon. For this purpoſe ſhe commenced an iniquitous ſuit againſt him; and by the chicanery of chancellor du Prat, the conſtable was ſtripped of his whole family-eſtate. Driven to deſpair by ſo many injuries, he entered into a ſecret correſpondence with the emperor and the king of England; and he propoſed, as ſoon as Francis ſhould have croſſed the Alps, to raiſe an inſurrection among his numerous vaſſals, and introduce foreign enemies into the heart of France.

Happily Francis got intimation of this conſpiracy before he left the kingdom; but not being ſufficiently convinced of the Conſtable's guilt, he ſuffered ſo dangerous a foe to eſcape; and Bourbon entering into the emperor's ſervice, employed all the force of his enterpriſing genius, and his great talents for war, to the prejudice of his prince and his native country.

In conſequence of the diſcovery of this plot, and the eſcape of the powerful conſpirator, Francis relinquiſhed his intention of leading his army in perſon into Italy. He was ignorant how far the infection had ſpread among his ſubjects, and afraid that his abſence might encourage them to make ſome deſperate attempt in favour of a man ſo much beloved. He did not, however, abandon his deſign on the Milaneſe, but ſent forward an army of 30,000 men, under the command of admiral Bonnivet. Colonna, who was entruſted with the defence of that duchy, was in no condition to reſiſt ſuch a force; and the city of Milan, on which the whole territory depends, muſt have fallen into the hands of the French, had not Bonnivet, who poſſeſſed none of the talents of a general, waſted his time in frivolous enterpriſes, till the inhabitants recovered from their conſternation. The imperial army was reinforced. Colonna died; and Lannoy, viceroy of Naples, ſucceeded him in the command: but the chief direction of military operations was committed to Bourbon and the marquis de Peſcara, the greateſt generals of their age. Bonnivet, deſtitute of troops to oppoſe this new army, and ſtill more of the talents which could render him a match for its leaders, after various movements and encounters, was reduced to the neceſſity of attempting a retreat into France. He was followed by the imperial generals, and routed at Biagraſſa, where the famous chevalier Bayard was killed.

83 A French army enters Italy.

84 Defeated at Biagraſſa.

The emperor and his allies were leſs ſucceſsful in their attempts upon France. They were baffled in every quarter: and Francis, though ſtripped of his Italian dominions, might ſtill have enjoyed in ſafety the glory of having defended his native kingdom againſt one half of Europe, and have bid defiance to all his enemies; but underſtanding that the king of England, diſcouraged by his former fruitleſs enterpriſes, and diſguſted with the emperor, was making no preparations for any attempt on Picardy, his ancient ardour ſeized him for the conqueſt of Milan, and he determined, notwithſtanding the advanced ſeaſon, to march into Italy. Spain

85 Francis determines to enter Italy in perſon.

The French army no ſooner appeared in Piedmont, than the whole Milaneſe was thrown into conſternation. The capital opened its gates. The forces of the emperor and Sforza retired to Lodi: and had Francis been ſo fortunate as to purſue them, they muſt have abandoned that poſt, and been totally diſperſed; but his evil genius led him to beſiege Pavia, a town of conſiderable ſtrength, well garriſoned, and defended by Antonio de Leyva, one of the braveſt officers in the Spaniſh ſervice; before which place he was defeated and taken priſoner on the twenty-fourth day of February 1524.

86 Is defeated and taken priſoner at Pavia.

The captivity of Francis filled all Europe with alarm. Almoſt the whole French army was cut off; Milan was immediately abandoned; and in a few weeks not a Frenchman was left in Italy. The power of the emperor, and ſtill more his ambition, became an object of univerſal terror; and reſolutions were everywhere taken to ſet bounds to it. Meanwhile Francis, deeply impreſſed with a ſenſe of his misfortune, wrote to his mother Louiſa, whom he had left regent of the kingdom, the following ſhort but expreſſive letter: "All, Madam, is loſt but honour." The ſame courier that carried this letter, carried alſo diſpatches to Charles; who received the news of the ſignal and unexpected ſucceſs which had crowned his arms with the moſt hypocritical moderation. He would not ſuffer any public rejoicings to be made on account of it; and ſaid, he only valued it, as it would prove the occaſion of reſtoring peace to Chriſtendom. Louiſa, however, did not truſt to thoſe appearances; if ſhe could not preſerve what was yet left, ſhe determined at leaſt that nothing ſhould be loſt through her negligence or weakneſs. Inſtead of giving herſelf up to ſuch lamentations as were natural to a woman ſo remarkable for maternal tenderneſs, ſhe diſcovered all the foreſight, and exerted all the activity, of a conſummate politician. She took every poſſible meaſure for putting the kingdom in a poſture of defence, while ſhe employed all her addreſs to appeaſe the reſentment and to gain the friendſhip of England; and a ray of comfort from that quarter ſoon broke in upon the French affairs.

87 Hypocritical conduct of Charles.

Though Henry VIII. had not entered into the war againſt France from any concerted political views, he had always retained ſome imperfect idea of that balance of power which it was neceſſary to maintain between Charles and Francis; and the preſervation of which he boaſted to be his peculiar office. By his alliance with the emperor, he hoped to recover ſome part of thoſe territories on the continent which had belonged to his anceſtors; and therefore willingly contributed to give him the aſcendency above his rival; but having never dreamt of any event ſo deciſive and fatal as the victory at Pavia, which ſeemed not only to have broken, but to have annihilated the power of Francis, he now became ſenſible of his own danger, as well as that of all Europe, from the loſs of a proper counterpoiſe to the power of

Spain.

88 France aſſiſted by Henry VIII.

Charles. Inſtead of taking advantage of the diſtreſſed condition of France, Henry therefore determined to aſſiſt her in her preſent calamities. Some diſguſts alſo had taken place between him and Charles, and ſtill more between Charles and Wolſey. The elevation of the cardinal of Medici to St Peter's chair, on the death of Adrian, under the name of Clement VII. had made the Engliſh miniſter ſenſible of the inſincerity of the emperor's promiſes, while it extinguiſhed all his hopes of the papacy; and he reſolved on revenge. Charles, too, had ſo ill ſupported the appearance of moderation which he aſſumed, when firſt informed of his good fortune, that he had already changed his uſual ſtyle to Henry; and inſtead of writing to him with his own hand, and ſubſcribing himſelf "your affectionate ſon and couſin," he dictated his letters to a ſecretary, and ſimply ſubſcribed himſelf "Charles." Influenced by all theſe motives, together with the glory of raiſing a fallen enemy, Henry liſtened to the flattering ſubmiſſions of Louiſa; entered into a defenſive alliance with her as regent of France, and engaged to uſe his beſt offices in order to procure the deliverance of her ſon from a ſtate of captivity.

89 Francis ſeverely uſed by his conqueror.

Meanwhile Francis was rigorouſly confined; and ſevere conditions being propoſed to him as the price of his liberty, he drew his dagger, and, pointing it at his breaſt, cried, "'Twere better that a king ſhould die thus!" His hand was with-held: and flattering himſelf, when he grew cool, that ſuch propoſitions could not come directly from Charles, he deſired that he might be removed to Spain, where the emperor then reſided. His requeſt was complied with; but he languiſhed long before he obtained a ſight of his conqueror. At laſt he was favoured with a viſit; and the emperor dreading a general combination againſt him, or that Francis, as he threatened, might, in the obſtinacy of his heart, reſign his crown to the dauphin, agreed to abate ſomewhat of his former demands. A treaty was accordingly concluded at Madrid; in conſequence of which Francis obtained his liberty. The chief article in this treaty was, that Burgundy ſhould be reſtored to Charles as the rightful inheritance of his anceſtors, and that Francis's two eldeſt ſons ſhould be immediately delivered up as hoſtages for the performance of the conditions ſtipulated. The exchange of the captive monarch for his children was made on the borders between France and Spain. The moment that Francis entered his own dominions, he mounted a Turkiſh horſe, and putting it to its ſpeed, waved his hand, and cried aloud ſeveral times, "I am yet a king! I am yet a king!"

90 Is at laſt releaſed.

91 Refuſes to execute the conditions of his releaſe.

Francis never meant to execute the treaty of Madrid: he had even left a proteſt in the hands of notaries before he ſigned it, that his conſent ſhould be conſidered as an involuntary deed, and be deemed null and void. Accordingly, as ſoon as he arrived in France, he aſſembled the ſtates of Burgundy, who proteſted againſt the article relative to their province; and Francis coldly replied to the imperial ambaſſadors, who urged the immediate execution of the treaty, that he would religiouſly perform the articles relative to himſelf, but in thoſe affecting the French monarchy, he muſt be directed by the ſenſe of the nation. He made the higheſt acknowledgments to the king of England for his friendly interpoſition, and offered to be entirely guided by his counſels. Charles and his miniſters ſaw that they were over-reached in thoſe very arts of negociation in which they ſo much excelled, while the Italian ſtates obſerved with pleaſure, that Francis was reſolved not to execute a treaty which they conſidered as dangerous to the liberties of Europe. Clement abſolved him from the oath which he had taken at Madrid; and the kings of France and England, the Pope, the Swiſs, the Venetians, the Florentines, and the duke of Milan, entered into an alliance, to which they gave the name of the *Holy League*, becauſe his Holineſs was at the head of it, in order to oblige the emperor to deliver up Francis's two ſons on the payment of a reaſonable ranſom, and to re-eſtabliſh Sforza in the quiet poſſeſſion of the Milaneſe. Spain.

In conſequence of this league, the confederate army took the field, and Italy once more became the ſcene of war. But Francis, who it was thought would have infuſed ſpirit and vigour into the whole body, had gone through ſuch a ſcene of diſtreſs, that he was become diffident of himſelf, diſtruſtful of his fortune, and deſirous of tranquillity. He flattered himſelf, that the dread alone of ſuch a confederacy would induce Charles to liſten to what was equitable, and therefore neglected to ſend due reinforcements to his allies in Italy. Meantime the duke of Bourbon, who commanded the Imperialiſts, had made himſelf maſter of the whole Milaneſe, of which the emperor had promiſed him the inveſtiture; and his troops beginning to mutiny for want of pay, he led them to Rome, and promiſed to enrich them with the ſpoils of that city. He was as good as his word; for though he himſelf was ſlain in planting a ſcaling ladder againſt the walls, his ſoldiers, rather enraged than diſcouraged by his death, mounted to the aſſault with the utmoſt ardour, animated by the greatneſs of the prize, and, entering the city ſword in hand, plundered it for ſeveral days.

92 Rome taken by the imperialiſts.

93 And moſt cruelly plundered.

Never did Rome in any age ſuffer ſo many calamities, not even from the Barbarians, by whom ſhe was often ſubdued, the Huns, Vandals, or Goths, as now from the ſubjects of a Chriſtian and Catholic monarch. Whatever was reſpectable in modeſty, or ſacred in religion, ſeemed only the more to provoke the rage of the ſoldiery. Virgins ſuffered violation in the arms of their parents, and upon thoſe altars to which they had fled for ſafety. Venerable prelates, after enduring every indignity and every torture, were thrown into dungeons, and menaced with the moſt cruel death, in order to make them reveal their ſecret treaſures. Clement himſelf, who had neglected to make his eſcape in time, was taken priſoner, and found that the ſacredneſs of his character could neither procure him liberty nor reſpect. He was confined till he ſhould pay an enormous ranſom impoſed by the victorious army, and ſurrender to the emperor all the places of ſtrength belonging to the church.

94 The Pope confined.

95 Shameful hypocriſy of Charles.

Charles received the news of this extraordinary event with equal ſurpriſe and pleaſure; but in order to conceal his joy from his Spaniſh ſubjects, who were filled with horror at the inſult offered to the ſovereign pontiff, and to leſſen the indignation of the reſt of Europe, he expreſſed the moſt profound ſorrow for the ſucceſs of his arms. He put himſelf and his court into mourning; ſtopped the rejoicings for the birth of his ſon Philip, and ordered prayers to be put up in all the churches of Spain for the recovery of the pope's liberty,

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which he could immediately have procured by a letter to his generals.

The concern expreſſed by Henry and Francis for the calamity of their ally was more ſincere. Alarmed at the progreſs of the imperial arms, they had, even before the taking of Rome, entered into a cloſer alliance, and agreed to invade the Low Countries with a powerful army; but no ſooner did they hear of the Pope's captivity, than they changed, by a new treaty, the ſcene of the projected war from the Netherlands to Italy, and reſolved to take the moſt vigorous meaſures for reſtoring him to liberty. Henry, however, contributed only money. A French army entered Italy, under the command of Marſhal Lautrec; Clement obtained his freedom; and war was for a time carried on by the confederates with ſucceſs; but the death of Lautrec, and the revolt of Andrew Doria, a Genoeſe admiral in the ſervice of France, entirely changed the face of affairs. The French army was utterly ruined; and Francis, diſcouraged and almoſt exhauſted by ſo many unſucceſsful enterpriſes, began to think of peace, and of obtaining the releaſe of his ſons by conceſſions, not by the terror of his arms.

96 A French army enters Italy, but is utterly ruined.

At the ſame time Charles, notwithſtanding the advantages he had gained, had many reaſons to wiſh for an accommodation. Sultan Solyman having over-run Hungary, was ready to break in upon the Auſtrian territories with the whole force of the Eaſt; and the progreſs of the Reformation in Germany threatened the tranquillity of the empire. In conſequence of this ſituation of affairs, though pride made both parties conceal or diſſemble their real ſentiments, two ladies were permitted to reſtore peace to Europe. Margaret of Auſtria, Charles's aunt, and Louiſa, Francis's mother, met in 1529 at Cambray, and ſettled the terms of accommodation between the French king and the emperor. Francis agreed to pay two millions of crowns as the ranſom of his two ſons, to reſign the ſovereignty of Flanders and Artois, and to forego all his Italian claims; and Charles ceaſed to demand the reſtitution of Burgundy.

97 Peace concluded at Cambray.

All the ſteps of this negociation had been communicated to the king of England; and Henry was, on that occaſion, ſo generous to his friend and ally Francis, that he ſent him an acquittal of near ſix hundred thouſand crowns, in order to enable him to fulfil his agreement with Charles. But Francis's Italian confederates were leſs ſatisfied with the treaty of Cambray. They were almoſt wholly abandoned to the will of the emperor; and ſeemed to have no other means of ſecurity left but his equity and moderation. Of theſe, from his paſt conduct, they had not formed the moſt advantageous idea. But Charles's preſent circumſtances, more eſpecially in regard to the Turks, obliged him to behave with a generoſity inconſiſtent with his character. The Florentines alone, whom he reduced under the dominion of the family of Medici, had reaſon to complain of his ſeverity. Sforza obtained the inveſtiture of Milan and his pardon; and every other power experienced the lenity of the conqueror.

98 Charles goes into Germany.

After having received the imperial crown from the hands of the Pope at Bologna, Charles proceeded on his journey to Germany, where his preſence was become highly neceſſary; for although the conduct and valour of his brother Ferdinand, on whom he had conferred the hereditary dominions of the houſe of Auſtria, and who had been elected king of Hungary, had obliged Solyman to retire with infamy and loſs, his return was to be feared, and the diſorders of religion were daily increaſing; an account of which, and of the emperor's tranſactions with the Proteſtants, is given under the article REFORMATION.

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Charles having exerted himſelf as much as he could againſt the reformers, undertook his firſt expedition againſt the piratical ſtates of Africa. Barbary, or that part of the African continent lying along the coaſt of the Mediterranean ſea, was then nearly in the ſame condition which it is at preſent. Morocco, Algiers, and Tunis, were its principal ſtates; and the two laſt were neſts of pirates. Barbaroſſa, a famous Corſair, had ſucceeded his brother in the kingdom of Algiers, which he had formerly aſſiſted him to uſurp. He regulated with much prudence the interior police of his kingdom, carried on his piracies with great vigour, and extended his conqueſts on the continent of Africa; but perceiving that the natives ſubmitted to his government with impatience, and fearing that his continual depredations would one day draw upon him a general combination of the Chriſtian powers, he put his dominions under the protection of the grand ſeignior. Solyman, flattered by ſuch an act of ſubmiſſion, and charmed with the boldneſs of the man, offered him the command of the Turkiſh fleet. Proud of this diſtinction, Barbaroſſa repaired to Conſtantinople, and made uſe of his influence with the ſultan to extend his own dominion. Partly by force, partly by treachery, he uſurped the kingdom of Tunis; and being now poſſeſſed of greater power, he carried on his depredations againſt the Chriſtian ſtates with more deſtructive violence than ever.

99 He undertakes an expedition againſt the ſtate of Barbary.

Daily complaints of the piracies and ravages committed by the galleys of Barbaroſſa were brought to the emperor by his ſubjects, both in Spain and Italy; and all Chriſtendom ſeemed to look up to him, as its greateſt and moſt fortunate prince, for relief from this new and odious ſpecies of oppreſſion. At the ſame time Muley-Haſcen, the exiled king of Tunis, finding none of the African princes able or willing to ſupport him in recovering his throne, applied to Charles for aſſiſtance againſt the uſurper. Equally deſirous of delivering his dominions from the dangerous neighbourhood of Barbaroſſa, of appearing as the protector of an unfortunate prince, and of acquiring the glory annexed in that age to every expedition againſt the Mahometans, the emperor readily concluded a treaty with Muley Haſcen, and ſet ſail for Tunis with a formidable armament. The Goletta, a ſea-port town, fortified with 300 pieces of cannon, was taken, together with all Barbaroſſa's fleet: he was defeated in a pitched battle, and 10,000 Chriſtian ſlaves, having knocked off their fetters, and made themſelves maſters of the citadel, Tunis was preparing to ſurrender. But while Charles was deliberating on the conditions, his troops fearing that they would be deprived of the booty which they had expected, broke ſuddenly into the town, and pillaged and maſſacred without diſtinction. Thirty thouſand perſons periſhed by the ſword, and 10,000 were made priſoners. The ſceptre was reſtored to Muley Haſcen, on condition that he ſhould acknowledge himſelf a vaſſal of the crown of Spain, put into the emperor's hands all the fortified ſea-ports in the kingdom of Tunis, and

100 Tunis taken and the inhabitants cruelly maſſacred.

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pay annually 12,000 crowns for the ſubſiſtence of the Spaniſh garriſon in the Goletta. Theſe points being ſettled, and 20,000 Chriſtian ſlaves freed from bondage either by arms or by treaty, Charles returned to Europe, where his preſence was become neceſſary; while Barbaroſſa, who had retired to Bona, recovered new ſtrength, and again became the tyrant of the ocean.

101 Francis attempts in vain to revive his pretenſions to Italy.

The king of France took advantage of the emperor's abſence to revive his pretenſions in Italy. The treaty of Cambray had covered up but not extinguiſhed the flames of diſcord. Francis in particular, who waited only for a favourable opportunity of recovering the territories and reputation which he had loſt, continued to negotiate againſt his rival with different courts. But all his negotiations were diſconcerted by unforeſeen accidents. The death of Clement VII. (whom he had gained by marrying his ſon the duke of Orleans, afterwards Henry II. to Catharine of Medici, the niece of that pontiff), deprived him of all the ſupport which he hoped to receive from the court of Rome. The king of England, occupied with domeſtic cares and projects, declined engaging in the affairs of the continent; and the Proteſtant princes, aſſociated by the league of Smalkalde, to whom Francis had alſo applied, and who ſeemed diſpoſed at firſt to liſten to him, filled with indignation and reſentment at the cruelty with which ſome of their reformed brethren had been treated in France, refuſed to have any connection with the enemy of their religion.

Francis was neither cruel nor bigotted: he was too indolent to concern himſelf about religious diſputes; but his principles becoming ſuſpected, at a time when the emperor was gaining immortal glory by his expedition againſt the Infidels, he found it neceſſary to vindi-

102 His barbarity to the Proteſtants.

cate himſelf by ſome extraordinary demonſtration of reverence for the eſtabliſhed faith. The indiſcreet zeal of ſome Proteſtant converts furniſhed him with the occaſion. They had affixed to the gates of the Louvre and other public places papers containing indecent reflections on the rites of the Romiſh church. Six of the perſons concerned in this rath action were ſeized; and the king, pretending to be ſtruck with horror at their blaſphemies, appointed a ſolemn proceſſion, in order to avert the wrath of heaven. The holy ſacrament was carried through the city of Paris in great pomp: Francis walked uncovered before it, bearing a torch in his hand; the princes of the blood ſupported the canopy over it; the nobles walked behind. In preſence of this numerous aſſembly, the king declared, that if one of his hands were infected with hereſy, he would cut it off with the other; "and I would ſacrifice (added he) even my own children, if found guilty of that crime." As an awful proof of his ſincerity, the ſix unhappy perſons who had been ſeized were publicly burnt, before the proceſſion was finiſhed, and in the moſt cruel manner. They were fixed upon a machine which deſcended into the flames, and retired alternately, until they expired.—No wonder that the Proteſtant princes were incenſed at ſuch barbarity!

103 Cauſes an army march towards Italy.

But Francis, though unſupported by any ally, commanded his army to advance towards the frontiers of Italy, under pretence of chaſtiſing the duke of Milan for a breach of the law of nations, in putting to death his ambaſſador. The operations of war, however, ſoon took a new direction. Inſtead of marching directly to the Milaneſe, Francis commenced hoſtilities againſt the duke of Savoy, with whom he had cauſe to be diſſatisfied, and on whom he had ſome claims; and before the end of the campaign, that feeble prince ſaw himſelf ſtripped of all his dominions, except the province of Piedmont. To complete his misfortunes, the city of Geneva, the ſovereignty of which he claimed, and where the reformed opinions had already got footing, threw off his yoke; and its revolt drew along with it the loſs of the adjacent territory. Geneva was then an imperial city, and has ever ſince remained entirely free.

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104 Geneva throws off the yoke of the duke of Savoy.

In this extremity the duke of Savoy ſaw no reſource but in the emperor's protection; and as his misfortunes were chiefly occaſioned by his attachment to the imperial intereſt, he had a title to immediate aſſiſtance. But Charles, who was juſt returned from his African expedition, was not able to lend him the neceſſary ſupport. His treaſury was entirely drained, and he was obliged to diſband his army till he could raiſe new ſupplies. Mean time the death of Sforza duke of Milan entirely changed the nature of the war, and afforded the emperor full leiſure to prepare for action. The French monarch's pretext for taking up arms was at once cut off; but as the duke died without iſſue, all Francis's rights to the duchy of Milan, which he had yielded only to Sforza and his deſcendants, returned to him in full force. He inſtantly renewed his claim to it; and if he had ordered his army immediately to advance, he might have made himſelf maſter of it. But he unfortunately waſted his time in fruitleſs negotiations, while his more politic rival took poſſeſſion of the duchy as a vacant fief of the empire; and though Charles ſeemed ſtill to admit the equity of Francis's claim, he delayed granting the inveſtiture under various pretences, and was ſecretly taking every poſſible meaſure to prevent him from regaining footing in Italy.

105 Charles takes poſſeſſion of Milan.

During the time gained in this manner Charles had recruited his finances, and of courſe his armies; and finding himſelf in a condition for war, he at laſt threw off the maſk under which he had ſo long concealed his deſigns from the court of France. Entering Rome with great pomp, he pronounced before the pope and cardinals, aſſembled in full conſiſtory, a violent invective againſt Francis, by way of reply to his propoſitions concerning the inveſtiture of Milan. Yet Francis, by an unaccountable fatality, continued to negotiate, as if it had been ſtill poſſible to terminate their differences in an amicable manner; and Charles, finding him ſo eager to run into the ſnare, favoured the deception, and, by ſeeming to liſten to his propoſals, gained yet more time for the execution of his ambitious projects.

106 Weakneſs of Francis.

107 Charles attempts to ſubvert the French monarchy.

If misfortunes had rendered Francis too diffident, ſucceſs had made Charles too ſanguine. He preſumed on nothing leſs than the ſubverſion of the French monarchy; nay, he conſidered it as an infallible event. Having chaſed the forces of his rival out of Piedmont and Savoy, he puſhed forward at the head of 50,000 men, contrary to the advice of his moſt experienced miniſters and generals, to invade the ſouthern provinces of France; while other two armies were ordered to enter it, the one on the ſide of Picardy, the other on the ſide of Champagne. He thought it impoſſible that Francis could reſiſt ſo many unexpected attacks on ſuch different quarters; but he found himſelf miſtaken.

The French monarch fixed upon the moſt effectual

plan

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plan for defeating the invaſion of a powerful enemy; and he prudently perſevered in following it, though contrary to his own natural temper and to the genius of his people. He determined to remain altogether upon the defenſive, and to deprive the enemy of ſubſiſtence by laying waſte the country before them. The execution of this plan was committed to the mareſchal Montmorency its author, a man happily fitted for ſuch a truſt by the inflexible ſeverity of his diſpoſition. He made choice of a ſtrong camp, under the walls of Avignon, at the confluence of the Rhone and Durance, where he aſſembled a conſiderable army; while the king, with another body of troops, encamped at Valence, higher up the Rhone. Marſeilles and Arles were the only towns he thought it neceſſary to defend; and each of theſe he furniſhed with a numerous garriſon of his beſt troops. The inhabitants of the other towns were compelled to abandon their habitations: the fortifications of ſuch places as might have afforded ſhelter to the enemy were thrown down; corn, forage, and proviſions of every kind, were carried off or deſtroyed; the mills and ovens were ruined, and the wells filled up or rendered uſeleſs.

108 But is diſappointed in his deſigns.

This devaſtation extended from the Alps to Marſeilles, and from the ſea to the confines of Dauphiny; ſo that the emperor, when he arrived with the van of his army on the confines of Provence, inſtead of that rich and populous country which he expected to enter, beheld nothing but one vaſt and deſert ſolitude. He did not, however, deſpair of ſucceſs, though he ſaw that he would have many difficulties to encounter; and as an encouragement to his officers, he made them liberal promiſes of lands and honours in France. But all the land which any of them obtained was a grave, and their maſter loſt much honour by this raſh and preſumptuous enterprize. After unſucceſsfully inveſting Marſeilles and Arles, after attempting in vain to draw Montmorency from his camp at Avignon, and not daring to attack it, Charles having ſpent two inglorious months in Provence, and loſt one half of his troops by diſeaſe or by famine, was under the neceſſity of ordering a retreat; and though he was ſome time in motion before the enemy ſuſpected his intention, it was conducted with ſo much precipitation and diſorder, as to deſerve the name of a flight, ſince the light troops of France turned it into a perfect rout. The invaſion of Picardy was not more ſucceſsful: the imperial forces were obliged to retire without effecting any conqueſt of importance.

Charles had no ſooner conducted the ſhattered remains of his army to the frontiers of Milan, than he ſet out for Genoa; and unwilling to expoſe himſelf to the ſcorn of the Italians after ſuch a reverſe of fortune, he embarked directly for Spain.

109 Violent animoſity between him and Francis.

Meanwhile Francis gave himſelf up to that vain reſentment which had formerly diſgraced the proſperity of his rival. They had frequently, in the courſe of their quarrels, given each other the lie, and mutual challenges had been ſent; which, though productive of no ſerious conſequences between the parties, had a powerful tendency to encourage the pernicious practice of duelling. Charles, in his invective pronounced at Rome, had publicly accuſed Francis of perfidy and breach of faith; Francis now exceeded Charles in the indecency of his accuſations. The Dauphin dying ſuddenly, his death was imputed to poiſon: Montecuculi his cup-bearer was put to the rack; and that unhappy nobleman, in the agonies of torture, accuſed the emperor's generals Gonzaga and de Leyva, of inſtigating him to the deteſtable act. The emperor himſelf was ſuſpected; nay, this extorted confeſſion, and ſome obſcure hints, were conſidered as inconteſtable proofs of his guilt; though it was evident to all mankind, that neither Charles nor his generals could have any inducement to perpetrate ſuch a crime, as Francis was ſtill in the vigour of life himſelf, and had two ſons beſides the dauphin, grown up to a good age.

Spain.

But the incenſed monarch's reſentment did not ſtop here. Francis was not ſatisfied with endeavouring to blacken the character of his rival by an ambiguous teſtimony which led to the moſt injurious ſuſpicions, and upon which the moſt cruel conſtructions had been put; he was willing to add rebellion to murder. For this purpoſe he went to the parliament of Paris; where being ſeated with the uſual ſolemnities, the advocate-general appeared, and accuſed Charles of Auſtria (ſo he affected to call the emperor) of having violated the treaty of Cambray, by which he was freed from the homage due to the crown of France for the counties of Artois and Flanders; adding, that this treaty being now void, he was ſtill to be conſidered as a vaſſal of France, and conſequently had been guilty of rebellion in taking arms againſt his ſovereign. The charge was ſuſtained, and Charles was ſummoned to appear before the parliament of Paris at a day fixed. The term expired; and no perſon appearing in the emperor's name, the parliament gave judgment, that Charles of Auſtria had forfeited, by rebellion and contumacy, the counties of Flanders and Artois, and declared theſe fiefs reunited to the crown of France.

110 Charles ſummoned to appear at Paris.

Francis, ſoon after this vain diſplay of his animoſity, marched into the Low Countries as if he had intended to execute the ſentence pronounced by his parliament; but a ſuſpenſion of arms took place, through the interpoſition of the queens of France and Hungary, before any thing of conſequence was effected: and this ceſſation of hoſtilities was followed by a truce, concluded at Nice, through the mediation of the reigning pontiff Paul III. of the family of Farneſe, a man of a venerable character and pacific diſpoſition.

Each of theſe rival princes had ſtrong reaſons to incline them to peace. The finances of both were exhauſted; and the emperor, the moſt powerful of the two, was deeply impreſſed with the dread of the Turkiſh arms, which Francis had drawn upon him by a league with Solyman. In conſequence of this league, Barbaroſſa with a great fleet appeared on the coaſt of Naples; filled that kingdom with conſternation; landed without reſiſtance near Taranto; obliged Caſtro, a place of ſome ſtrength, to ſurrender; plundered the adjacent country; and was taking meaſures for ſecuring and extending his conqueſts, when the unexpected arrival of Doria, the famous Genoeſe admiral, together with the pope's galleys and a ſquadron of the Venetian fleet, made it prudent for him to retire. The ſultan's forces alſo invaded Hungary, where Mahmet the Turkiſh general, after gaining ſeveral inferior advantages, defeated the Germans in a great battle at Eſſek on the Drave. Happily for Charles and Europe it was not in Francis's power at this juncture either to join the Turks or aſ-

111 Francis leagues with the Turks.

ſemble

Spain.

semble an army ſtrong enough to penetrate into the Milaneſe. The emperor, however, was ſenſible that he could not long reſiſt the efforts of two ſuch powerful confederates, nor expect that the ſame fortunate circumſtances would concur a ſecond time in his favour; he therefore thought it neceſſary, both for his ſafety and reputation, to give his conſent to a truce: and Francis choſe rather to run the riſk of diſobliging his new ally the ſultan, than to draw on his head the indignation, and perhaps the arms, of all Chriſtendom, by obſtinately obſtructing the re-eſtabliſhment of tranquillity, and contributing to the aggrandizement of the Infidels.

112 A truce concluded.

Theſe conſiderations inclined the contending monarchs to liſten to the arguments of the holy father; but he found it impoſſible to bring about a final accommodation between them, each inflexibly perſiſting in aſſerting his own claims. Nor could he prevail on them to ſee one another, though both came to the place of rendezvous: ſo great was the remains of diſtruſt and rancour, or ſuch the difficulty of adjuſting the ceremonial! Yet, improbable as it may ſeem, a few days after ſigning the truce, the emperor, in his paſſage to Barcelona, being driven on the coaſt of Provence, Francis invited him to come aſhore; frankly viſited him on board his galley, and was received and entertained with the warmeſt demonſtrations of eſteem and affection. Charles, with an equal degree of confidence, paid the king next day a viſit at Aigues-mortes; where theſe two hoſtile rivals and vindictive enemies, who had accuſed each other of every kind of baſeneſs, converſing together with all the cordiality of brothers, ſeemed to vie with each other in expreſſions of reſpect and friendſhip.

113 Interview between Francis and Charles.

114 Advantage gained by the pope from this pacification.

Beſides the glory of having reſtored tranquillity to Europe, the pope gained a point of much conſequence to his family. He obtained for his grandſon, Margaret of Auſtria, the emperor's natural daughter, formerly wife of Alexander de Medici, whom Charles had raiſed to the ſupreme power in Florence. Lorenzo de Medici, the kinſman and intimate companion of Alexander, had aſſaſſinated him by one of the blackeſt treaſons recorded in hiſtory. Under pretence of having ſecured him an aſſignation with a lady of the higheſt rank and great beauty, he drew him into a ſecret apartment of his houſe, and there ſtabbed him as he lay careleſsly on a couch, expecting the embrace of the lovely fair, whom he had often ſolicited in vain. Lorenzo, however, did not reap the fruits of his crime; for though ſome of his countrymen extolled him as a third Brutus, and endeavoured to ſeize this occaſion for recovering their liberties, the government of Florence paſſed into the hands of Coſmo II. another kinſman of Alexander. Coſmo was deſirous of marrying the widow of his predeceſſor; but the emperor choſe rather to oblige the pope, by beſtowing his daughter upon Octavio Farneſe, ſon of the duke of Parma.

115 Charles diſtreſſed.

Charles had ſoon farther cauſe to be ſenſible of his obligations to the holy father for bringing about the treaty of Nice. His troops everywhere mutinied for want of pay, and the ability of his generals only could have prevented a total revolt. He had depended, as his chief reſource for diſcharging the arrears due to his ſoldiers, upon the ſubſidies which he expected from his Caſtilian ſubjects. For this purpoſe he aſſembled the Cortes of Caſtile at Toledo; and having repreſented to them the great expence of his military operations, he propoſed to levy ſuch ſupplies as the preſent exigency of affairs demanded, by a general exciſe on commodities; but the Spaniards, who already felt themſelves oppreſſed by a load of taxes unknown to their anceſtors, and who had often complained that their country was drained of its wealth and inhabitants, in order to proſecute quarrels in which they had no intereſt, determined not to add voluntarily to their own burdens. The nobles, in particular, inveighed with great vehemence againſt the impoſition propoſed, as an encroachment on the valuable and diſtinguiſhing privilege of their order, that of being exempted from the payment of any tax. After employing arguments and promiſes in vain, Charles diſmiſſed the aſſembly with indignation; and from that period neither the nobles nor the prelates have been called to the Cortes, on pretence that ſuch as pay no part of the public taxes ſhould not claim a vote in laying them on. Theſe aſſemblies have ſince conſiſted merely of the procurators or repreſentatives of 18 cities, two from each; in all 36 members, who are abſolutely at the devotion of the crown.

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116 The Spaniards refuſe to aſſiſt him with money.

117 Inhabitants of Ghent rebel.

The citizens of Ghent, ſtill more bold, broke out not long after into open rebellion againſt the emperor's government, on account of a tax which they judged contrary to their ancient privileges, and a deciſion of the council of Mechlin in favour of the imperial authority. Enraged at an unjuſt impoſition, and rendered deſperate on ſeeing their rights betrayed by that very court which was bound to protect them, they flew to arms, ſeized ſeveral of the emperor's officers, and drove ſuch of the nobility as reſided among them out of the city. Senſible, however, of their inability to ſupport what their zeal had prompted them to undertake, and deſirous of ſecuring a protector againſt the formidable forces with which they might expect ſoon to be attacked, they offered to acknowledge the king of France as their ſovereign, to put him into immediate poſſeſſion of their city, and to aſſiſt him in recovering thoſe provinces in the Netherlands which had anciently belonged to his crown. True policy directed Francis to comply with this propoſal. The counties of Flanders and Artois were more valuable than the duchy of Milan, for which he had ſo long contended; and their ſituation in regard to France made it more eaſy to conquer or to defend them. But Francis over-rated the Milaneſe. He had lived in friendſhip with the emperor ever ſince their interview at Aigues-mortes, and Charles had promiſed him the inveſtiture of that duchy. Forgetting, therefore, all his paſt injuries, and the deceitful promiſes by which he had been ſo often duped, the credulous, generous Francis, not only rejected the propoſitions of the citizens of Ghent, but communicated to the emperor his whole negociation with the malecontents.

118 Extreme credulity of Francis.

Judging of Charles's heart by his own, Francis hoped by this ſeemingly diſintereſted proceeding to obtain at once the inveſtiture of Milan; and the emperor, well acquainted with the weakneſs of his rival, flattered him in this apprehenſion, for his own ſelfiſh purpoſes. His preſence being neceſſary in the Netherlands, he demanded a paſſage through France. It was immediately granted him; and Charles, to whom every moment was precious, ſet out, notwithſtanding the remonſtrances of his council and the fears of his Spaniſh ſubjects, with a ſmall

119 He allows Charles to paſs thro' his dominions.

Spain. small but splendid train of 100 persons. He was met on the frontiers of France by the dauphin and the duke of Orleans, who offered to go into Spain, and remain there as hostages, till he should reach his own dominions; but Charles replied, that the king's honour was sufficient for his safety, and prosecuted his journey without any other security. The king entertained him with the utmost magnificence at Paris, and the two young princes did not take leave of him till he entered the Low Countries; yet he still found means to evade his promise, and Francis continued to believe him sincere.

120 Severity of Charles to the city of Ghent.

The citizens of Ghent, alarmed at the approach of the emperor, who was joined by three armies, sent ambassadors to implore his mercy, and offered to throw open their gates. Charles only condescended to reply, "That he would appear among them as a sovereign and a judge, with the sceptre and the sword." He accordingly entered the place of his nativity on the anniversary of his birth; and instead of that lenity which might have been expected, exhibited an awful example of his severity. Twenty-six of the principal citizens were put to death; a greater number were banished; the city was declared to have forfeited its privileges; a new system of laws and political administration was prescribed; and a large fine was imposed on the inhabitants, in order to defray the expence of erecting a citadel, together with an annual tax for the support of a garrison. They were not only despoiled of their ancient immunities, but made to pay, like conquered people, for the means of perpetuating their own slavery.

121 His base treatment of Francis.

Having thus re-established his authority in the Low Countries, and being now under no necessity of continuing that scene of falsehood and dissimulation with which he had amused the French monarch, Charles began gradually to throw aside the veil under which he had concealed his intentions with respect to the Milanese, and at last peremptorily refused to give up a territory of such value, or voluntarily to make such a liberal addition to the strength of an enemy by diminishing his own power. He even denied that he had ever made any promise which could bind him to an action so foolish, and so contrary to his own interest.

This transaction exposed the king of France to as much scorn as it did the emperor to censure. The credulous simplicity of Francis seemed to merit no other return, after experiencing so often the duplicity and artifices of his rival. He remonstrated, however, and exclaimed as if this had been the first circumstance in which the emperor had deceived him. The insult offered to his understanding affected him even more sensibly than the injury done to his interest; and he discovered such resentment as made it obvious that he would seize on the first opportunity of revenge, and that a new war would soon desolate the European continent.

122 He is obliged to make concessions to the Protestants.

Meanwhile Charles was obliged to turn his attention towards the affairs of Germany. The Protestants having in vain demanded a general council, pressed him earnestly to appoint a conference between a select number of divines of each party, in order to examine the points in dispute. For this purpose a diet was assembled at Ratisbon: and such a conference, notwithstanding the opposition of the pope, was held with great solemnity in the presence of the emperor. But the divines chosen to manage the controversy, though men of learning and moderation, were only able to settle a few speculative opinions, all points relative to worship and jurisdiction serving to inflame the minds of the disputants. Charles, therefore, finding his endeavours to bring about an accommodation ineffectual, and being impatient to close the diet, prevailed on a majority of the members to approve of the following edict of recess; viz. that the articles concerning which the divines had agreed, should be held as points decided; that those about which they had differed, should be referred to the determination of a general council, or if that could not be obtained, to a national synod; and should it prove impracticable also to assemble a synod of Germany, that a general diet of the empire should be called within 18 months, in order to give final judgment on the whole controversy; that, in the mean time, no innovations should be attempted, nor any endeavours employed to gain proselytes. Spain.

This diet gave great offence to the pope. The bare mention of allowing a diet, composed chiefly of laymen, to pass judgment in regard to articles of faith, appeared to him no less criminal and profane than the worst of those heresies which the emperor seemed so zealous to suppress. The Protestants also were dissatisfied with it, as it considerably abridged the liberty which they at that time enjoyed. They murmured loudly against it; and Charles, unwilling to leave any seeds of discontent in the empire, granted them a private declaration, exempting them from whatever they thought injurious or oppressive in the recess, and ascertaining to them the full possession of all their former privileges.

The situation of the emperor's affairs at this juncture made these extraordinary concessions necessary. He foresaw a rupture with France to be unavoidable, and he was alarmed at the rapid progress of the Turks in Hungary. A great revolution had happened in that kingdom. John Zapol Scæpus, by the assistance of Solyman, had wrested from the king of the Romans a considerable part of the country. John died, and left an infant son. Ferdinand attempted to take advantage of the minority, in order to repossess himself of the whole kingdom; but his ambition was disappointed by the activity and address of George Martinuzzi, bishop of Waradin, who shared the regency with the queen. Sensible that he was unable to oppose the king of the Romans in the field, Martinuzzi satisfied himself with holding out the fortified towns, all of which he provided with every thing necessary for defence; and at the same time he sent ambassadors to Solyman, beseeching him to extend towards the son that imperial protection which had so generously maintained the father on his throne. Ferdinand used his utmost endeavours to thwart this negotiation, and even meanly offered to hold the Hungarian crown on the same ignominious condition by which John had held it, that of paying tribute to the Porte. But the sultan saw such advantages from espousing the interest of the young king, that he instantly marched into Hungary; and the Germans, having formed the siege of Buda, were defeated with great slaughter before that city. Solyman, however, instead of becoming the protector of the infant sovereign whom he had relieved, made use of this success to extend his own dominions: he sent the queen and her son into Transilvania, which province he allotted them, and added Hungary to the Ottoman empire.

Happily

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Happily for the Proteſtants, Charles received intelligence of this revolution ſoon after the diet at Ratiſbon; and by the conceſſions which he made them, he obtained ſuch liberal ſupplies, both of men and money, as left him under little anxiety about the ſecurity of Germany. He therefore haſtened to join his fleet and army in Italy, in order to carry into execution a great and favourite enterprize which he had concerted againſt Algiers: though it would certainly have been more conſiſtent with his dignity to have conducted the whole force of the empire againſt Solyman, the common enemy of Chriſtendom, who was ready to enter his Auſtrian dominions. But many reaſons induced Charles to prefer the African expedition: he wanted ſtrength, or at leaſt money, to combat the Turks in ſo diſtant a country as Hungary; and the glory which he had formerly acquired in Barbary led him to hope for the like ſucceſs, while the cries of his Spaniſh ſubjects rouſed him to take vengeance on their ravagers. But the unfortunate event of this expedition has already been related under the article ALGIERS, n° 14—20.

123 Undertakes an unſucceſsful expedition againſt Algiers.

124 War between Francis and Charles.

The loſs which the emperor ſuffered in this calamitous expedition encouraged the king of France to begin hoſtilities, on which he had been for ſome time reſolved; and an action diſhonourable to civil ſociety furniſhed him with too good a pretext for taking arms. The marquis del Guaſto, governor of the Milaneſe, having got intelligence of the motions and deſtination of two ambaſſadors, Rincon and Fergoſo, whom Francis had diſpatched, the one to the Ottoman Porte, the other to the republic of Venice; knowing how much his maſter wiſhed to diſcover the intentions of the French monarch, and of what conſequence it was to retard the execution of his meaſures, he employed ſome ſoldiers belonging to the garriſon of Pavia to lie in wait for theſe ambaſſadors as they ſailed down the Po, who murdered them and moſt of their attendants, and ſeized their papers. Francis immediately demanded reparation for this barbarous outrage; and as Charles endeavoured to put him off with an evaſive anſwer, he appealed to all the courts of Europe, ſetting forth the heinouſneſs of the injury, the iniquity of the emperor in diſregarding his juſt requeſt, and the neceſſity of vengeance. But Charles, who was a more profound negotiator, defeated in a great meaſure the effects of theſe repreſentations: he ſecured the fidelity of the Proteſtant princes in Germany, by granting them new conceſſions; and he engaged the king of England to eſpouſe his cauſe, under pretence of defending Europe againſt the Infidels; while Francis was only able to form an alliance with the kings of Denmark and Sweden (who for the firſt time intereſted themſelves in the quarrels of the more potent monarchs of the ſouth), and to renew his treaty with Solyman, which drew on him the indignation of Chriſtendom.

But the activity of Francis ſupplied all the defects of his negotiation. Five armies were ſoon ready to take the field, under different generals, and with different deſtinations. Nor was Charles wanting in his preparations. He and Henry a ſecond time made an ideal diviſion of the kingdom of France. But as the hoſtilities which followed terminated in nothing deciſive, and were diſtinguiſhed by no remarkable event, except the battle of Ceriſoles (gained by count d'Enguien over the imperialiſts, and in which 10,000 of the emperor's beſt troops fell), at laſt Francis and Charles, mutually tired of haraſſing each other, concluded at Creſpy a treaty of peace, in which the king of England was not mentioned; and from being implacable enemies, became once more, to appearance, cordial friends, and even allies by the ties of blood.

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125 Peace concluded at Creſpy.

The chief articles of this treaty were, that all the conqueſts which either party had made ſince the truce of Nice ſhould be reſtored; that the emperor ſhould give in marriage to the duke of Orleans, either his own eldeſt daughter, with the Low Countries, or the ſecond daughter of his brother Ferdinand, with the inveſtiture of the Milaneſe; that Francis ſhould renounce all pretenſions to the kingdom of Naples, as well as to the ſovereignty of Flanders and Artois, and Charles give up his claim to the duchy of Burgundy; and that both ſhould unite in making war againſt the Turks.

The emperor was chiefly induced to grant conditions ſo advantageous to France, by a deſire of humbling the Proteſtant princes in Germany. With the papal juriſdiction, he foreſaw they would endeavour to throw off the imperial authority; and he determined to make his zeal for the former a pretence for enforcing and extending the latter. However, the death of the duke of Orleans before the conſummation of his marriage, diſentangled the emperor from the moſt troubleſome ſtipulation in the treaty of Creſpy; and the French monarch, being ſtill engaged in hoſtilities with England, was unable to obtain any reparation for the loſs which he ſuffered by this unforeſeen event. Theſe hoſtilities, like thoſe between Charles and Francis, terminated in nothing deciſive. Equally tired of a ſtruggle attended with no glory or advantage to either, the contending princes concluded, at Campe, near Ardies, a treaty of peace; in which it was ſtipulated, that France ſhould pay the arrears due by former treaties to England. But theſe arrears did not exceed one-third of the ſums expended by Henry on his military operations; and Francis being in no condition to diſcharge them, Boulogne (a chargeable pledge) was left in the hands of the Engliſh as a ſecurity for the debt.

126 Charles obliged to conclude a diſadvantageous peace with the Turks and Proteſtants.

In conſequence of the emperor's reſolution to humble the Proteſtant princes, he concluded a diſhonourable peace with the Porte, ſtipulating that his brother Ferdinand ſhould pay tribute for that part of Hungary which he ſtill poſſeſſed; while the ſultan enjoyed the imperial and undiſturbed poſſeſſion of all the reſt. At the ſame time he entered into a league with pope Paul III. for the extirpation of hereſy; but in reality with a view to oppreſs the liberties of Germany. Here, however, his ambition met with a ſevere check; for though he was ſucceſsful at firſt, he was obliged in 1552 to conclude a peace with the Proteſtants on their own terms; as has been related under the article REFORMATION, n° 26—32.

127 Attempts to recover ſome of his provinces.

By the peace concluded on this occaſion the emperor loſt Metz, Toul, and Verdun, which had formed the barrier of the empire on that quarter; and therefore ſoon after put himſelf at the head of an army, in order to recover theſe three biſhopries. In order to conceal the deſtination of his army, he gave out, that he intended to lead it into Hungary, to ſecond Maurice in his operations againſt the Infidels; and as that pretext failed him, when he began to advance towards the Rhine, he propagated a report that he was marching

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first to chaſtiſe Albert of Brandenburgh, who had refuſed to be included in the treaty of Paſſau, and whoſe cruel exactions in that part of Germany called loudly for redreſs.

The French, however, were not deceived by theſe arts. Henry immediately gueſſed the true object of Charles's armament, and reſolved to defend his conqueſts with vigour. The defence of Metz, againſt which it was foreſeen the whole weight of the war would be turned, was committed to Francis of Lorraine, duke of Guiſe, who poſſeſſed in an eminent degree all the qualities that render men great in military command. He repaired with joy to the dangerous ſtation; and many of the French nobility, and even princes of the blood, eager to diſtinguiſh themſelves under ſuch a leader, entered Metz as volunteers. The city was of great extent, ill fortified, and the ſuburbs large. For all theſe defects the duke endeavoured to provide a remedy. He repaired the old fortifications with all poſſible expedition, labouring with his own hands; the officers imitated his example; and the ſoldiers, thus encouraged, cheerfully ſubmitted to the moſt ſevere toils; he erected new works, and he levelled the ſuburbs with the ground. At the ſame time he filled the magazines with proviſions and military ſtores, compelled all uſeleſs perſons to leave the place, and laid waſte the neighbouring country; yet ſuch were his popular talents, as well as his arts of acquiring an aſcendant over the minds of men, that the citizens not only refrained from murmuring, but ſeconded him with no leſs ardour than the ſoldiers in all his operations—in the ruin of their eſtates, and in the havoc of their public and private buildings.

128 Is obliged to raiſe the ſiege of Metz.

Meanwhile the emperor continued his march towards Lorraine, at the head of 60,000 men. On his approach Albert of Brandenburgh, whoſe army did not exceed 20,000, withdrew into that principality, as if he intended to join the French king; and Charles, notwithſtanding the advanced ſeaſon, it being towards the end of October, laid ſiege to Metz, contrary to the advice of his moſt experienced officers.

The attention of both the beſiegers and the beſieged was turned for ſome time towards the motions of Albert, who ſtill hovered in the neighbourhood, undetermined which ſide to take, though reſolved to ſell his ſervice. Charles at laſt came up to his price, and he joined the imperial army. The emperor now flattered himſelf that nothing could reſiſt his force; but he found himſelf deceived. After a ſiege of almoſt 60 days, during which he had attempted all that was thought poſſible for art or valour to effect, and had loſt upwards of 30,000 men by the inclemency of the weather, diſeaſes, or the ſword of the enemy, he was obliged to abandon the enterpriſe.

129 Miſerable condition of his army.

When the French ſallied out to attack the enemy's rear, the imperial camp was filled with the ſick and wounded, with the dead and the dying. All the roads by which the army retired were ſtrewed with the ſame miſerable objects; who, having made an effort beyond their ſtrength to eſcape, and not being able to proceed, were left to periſh without aſſiſtance. Happily that, and all the kind offices which their friends had not the power to perform, they received from their enemies. The duke of Guiſe ordered them all to be taken care of, and ſupplied with every neceſſary; he appointed phyſicians to attend, and direct what treatment was proper for the ſick and wounded, and what refreſhments for the feeble; and ſuch as recovered he ſent home, under an eſcort of ſoldiers, and with money to bear their charges. By theſe acts of humanity, leſs common in that age, the duke of Guiſe completed that heroic character which he had juſtly acquired by his brave and ſucceſsful defence of Metz.

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130 His further misfortunes.

The emperor's misfortunes were not confined to Germany. During his reſidence at Villach, he had been obliged to borrow 200,000 crowns of Coſmo de Medici; and ſo low was his credit, that he was obliged to put Coſmo in poſſeſſion of the principality of Piombino as a ſecurity for that inconſiderable ſum; by which means he loſt the footing he had hitherto maintained in Tuſcany. Much about the ſame time he loſt Sienna. The citizens, who had long enjoyed a republican government, roſe againſt the Spaniſh garriſon, which they had admitted as a check upon the tyranny of the nobility, but which they found was meant to enſlave them; forgetting their domeſtic animoſities, they recalled the exiled nobles; they demoliſhed the citadel, and put themſelves under the protection of France.

To theſe unfortunate events one ſtill more fatal had almoſt ſucceeded. The ſevere adminiſtration of the viceroy of Naples had filled that kingdom with murmuring and diſſatisfaction. The prince of Salerno, the head of the malecontents, fled to the court of France. The French monarch, after the example of his father, applied to the grand ſignior; and Solyman, at that time highly incenſed againſt the houſe of Auſtria on account of the proceedings in Hungary, ſent a powerful fleet into the Mediterranean, under the command of the corſair Dragut, an officer trained up under Barbaroſſa, and ſcarce inferior to his maſter in courage, talents, or in good fortune. Dragut appeared on the coaſt of Calabria at the time appointed; but not being joined by the French fleet according to concert, he returned to Conſtantinople, after plundering and burning ſeveral places, and filling Naples with conſternation.

131 Is ſucceſsful in the Low Countries.

Highly mortified by ſo many diſaſters, Charles retired into the Low Countries, breathing vengeance againſt France: and here the war was carried on with conſiderable vigour. Impatient to efface the ſtain which his military reputation had received before Metz, Charles laid ſiege to Terouane; and the fortifications being in diſrepair, that important place was carried by aſſault. Heſdin alſo was inveſted, and carried in the ſame manner. The king of France was too late in aſſembling his forces to afford relief to either of theſe places; and the emperor afterwards cautiouſly avoided an engagement.

132 But not ſo in other places.

The imperial arms were leſs ſucceſsful in Italy. The viceroy of Naples failed in an attempt to recovtr Siena; and the French not only eſtabliſhed themſelves more firmly in Tuſcany, but conquered part of the iſland of Corſica. Nor did the affairs of the houſe of Auſtria go on better in Hungary during the courſe of this year. Iſabella and her ſon appeared once more in Tranſylvania, at a time when the people were ready for revolt, in order to revenge the death of Martinuzzi, whoſe loſs they had ſeverely felt. Some noblemen of eminence declared in favour of the young king; and the baſhaw of Belgrade, by Solyman's order, eſpouſing his cauſe,

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in oppoſition to Ferdinand, Caſtaldo, the Auſtrian general, was obliged to abandon Tranſylvania to Iſabella and the Turks.

133 Marriage between Philip of Spain and Mary of England.

In order to counterbalance theſe and other loſſes, the emperor, in 1554, concerted a marriage between his ſon Philip and Mary of England, in hopes of adding that kingdom to his other dominions. Meanwhile the war between Henry and Charles was carried on with various ſucceſs in the Low Countries, and in Italy much to the diſadvantage of France. The French, under the command of Strozzi, were defeated in the battle of Merciano; Sienna was reduced by Medicino, the Florentine general, after a ſiege of ten months; and the gallant Sieneſe were ſubjected to the Spaniſh yoke. Much about the ſame time a plot was formed by the Franciſcans, but happily diſcovered before it could be carried into execution, to betray Metz to the Imperialiſts. The father-guardian, and twenty other monks, received ſentence of death on account of this conſpiracy; but the guardian, before the time appointed for his execution, was murdered by his incenſed accomplices, whom he had ſeduced; and ſix of the youngeſt were pardoned.

While war thus raged in Italy and the Low Countries, Germany enjoyed ſuch profound tranquillity, as afforded the diet full leiſure to confirm and perfect the plan of religious pacification agreed upon at Paſſau, and referred to the conſideration of the next meeting of the Germanic body. During the negociation of this treaty, an event happened which aſtoniſhed all Europe, and confounded the reaſonings of the wiſeſt politicians.

134 Charles reſigns his dominions to his ſon Philip.

The emperor Charles V. though no more than 56, an age when objects of ambition operate with full force on the mind, and are generally purſued with the greateſt ardour, had for ſome time formed the reſolution of reſigning his hereditary dominions to his ſon Philip. He now determined to put it in execution. Various have been the opinions of hiſtorians concerning a reſolution ſo ſingular and unexpected; but the moſt probable ſeem to be, the diſappointments which Charles had met with in his ambitious hopes, and the daily decline of his health. He had early in life been attacked with the gout; and the fits were now become ſo frequent and ſevere, that not only the vigour of his conſtitution was broken, but the faculties of his mind were ſenſibly impaired. He therefore judged it more decent to conceal his infirmities in ſome ſolitude, than to expoſe them any longer to the public eye; and as he was unwilling to forfeit the fame, or loſe the acquiſitions of his better years, by attempting to guide the reins of government when he was no longer able to hold them with ſteadineſs, he determined to ſeek in the tranquillity of retirement, that happineſs which he had in vain purſued amidſt the tumults of war and the intrigues of ſtate.

In conſequence of this reſolution, Charles, who had already ceded to his ſon Philip the kingdom of Naples and the duchy of Milan, aſſembled the ſtates of the Low Countries at Bruſſels; and ſeating himſelf for the laſt time in the chair of ſtate, he explained to his ſubjects the reaſons of his reſignation, and ſolemnly devolved his authority upon Philip. He recounted with dignity, but without oſtentation, all the great things which he had undertaken and performed ſince the commencement of his adminiſtration. "I have dedicated (obſerved he), from the 17th year of my age, all my thoughts and attention to public objects, reſerving no portion of my time for the indulgence of eaſe, and very little for the enjoyment of private pleaſure. Either in a pacific or hoſtile manner, I have viſited Germany nine times, Spain ſix times, France four times, Italy ſeven times, the Low Countries ten times, England twice, Africa as often; and while my health permitted me to diſcharge the duty of a ſovereign, and the vigour of my conſtitution was equal in any degree to the arduous office of governing ſuch extenſive dominions, I never ſhunned labour, nor repined under fatigue; but now, when my health is broken, and my vigour exhauſted by the rage of an incurable diſtemper, my growing infirmities admoniſh me to retire; nor am I ſo fond of reigning, as to retain the ſceptre in an impotent hand, which is no longer able to protect my ſubjects. Inſtead of a ſovereign worn out with diſeaſes (continued he), and ſcarce half alive, I give you one in the prime of life, already accuſtomed to govern, and who adds to the vigour of youth all the attention and ſagacity of maturer years." Then turning towards Philip, who fell on his knees, and kiſſed his father's hand, "It is in your power (ſaid Charles), by a wiſe and virtuous adminiſtration, to juſtify the extraordinary proof which I give this day of my paternal affection, and to demonſtrate that you are worthy of the extraordinary confidence which I repoſe in you. Preſerve (added he) an inviolable regard for religion; maintain the Catholic faith in its purity; let the laws of your country be ſacred in your eyes; encroach not on the rights of your people; and if the time ſhould ever come when you ſhall wiſh to enjoy the tranquillity of private life, may you have a ſon to whom you can reſign your ſceptre with as much ſatisfaction as I give up mine to you." A few weeks after, he reſigned to Philip the ſovereignty of Spain and America; reſerving nothing to himſelf out of all theſe vaſt poſſeſſions but an annual penſion of 100,000 crowns.

Charles was now impatient to embark for Spain, where he had fixed on a place of retreat; but by the advice of his phyſicians, he put off his voyage for ſome months, on account of the ſeverity of the ſeaſon; and, by yielding to their judgment, he had the ſatisfaction before he left the Low Countries of taking a conſiderable ſtep towards a peace with France. This he ardently longed for; not only on his ſon's account, whoſe adminiſtration he wiſhed to commence in quietneſs, but that he might have the glory, when quitting the world, of reſtoring to Europe that tranquillity which his ambition had baniſhed out of it almoſt from the time that he aſſumed the reins of government.

The great bar to ſuch a pacification, on the part of France, was the treaty which Henry had concluded with the Pope; and the emperor's claims were too numerous to hope for adjuſting them ſuddenly. A truce of five years was therefore propoſed by Charles; during which term, without diſcuſſing their reſpective pretenſions, each ſhould retain what was in his poſſeſſion; and Henry, through the perſuaſion of the conſtable Montmorency, who repreſented the imprudence of ſacrificing the true intereſts of his kingdom to the raſh engagements that he had come under with Paul, authoriſed his ambaſſadors to ſign at Vaucelles a treaty,

135 A truce of five years concluded with France.

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which would insure to him for so considerable a period the important conquest which he had made on the German frontier, together with the greater part of the duke of Savoy's dominions.

The Pope, when informed of this transaction, was no less filled with terror and astonishment than rage and indignation. But he took equal care to conceal his fear and his anger. He affected to approve highly of the truce; and he offered his mediation, as the common father of Christendom, in order to bring about a definitive peace. Under this pretext, he appointed cardinal Rebibo his nuncio to the court of Brussels, and his nephew cardinal Caraffa to that of Paris. The public instructions of both were the same; but Caraffa, besides these, received a private commission, to spare neither intreaties, promises, nor bribes, in order to induce the French monarch to renounce the truce and renew his engagements with the holy see. He flattered Henry with the conquest of Naples; he gained by his address the Guises, the queen, and even the famous Diana of Poictiers, duchess of Valentinois, the king's mistress; and they easily swayed the king himself, who already leaned to that side towards which they wished to incline him. All Montmorency's prudent remonstrances were disregarded; the nuncio (by powers from Rome) absolved Henry from his oath of truce; and that weak prince signed a new treaty with the Pope; which rekindled with fresh violence the flames of war, both in Italy and the Low Countries.

136 Quarrel betwixt the pope and king Philip.

No sooner was Paul made acquainted with the success of this negotiation than he proceeded to the most indecent extremities against Philip. He ordered the Spanish ambassador to be imprisoned; he excommunicated the Colonnas, because of their attachment to the imperial house; and he considered Philip as guilty of high treason, and to have forfeited his right to the kingdom of Naples, which he was supposed to hold of the holy see, for afterward affording them a retreat in his dominions.

Alarmed at a quarrel with the Pope, whom he had been taught to regard with the most superstitious veneration, as the vicegerent of Christ and the common father of Christendom, Philip tried every gentle method before he made use of force. He even consulted some Spanish divines on the lawfulness of taking arms against a person so sacred. They decided in his favour; and Paul continuing inexorable, the duke of Alva, to whom the negotiations as well as the war had been committed, entered the ecclesiastical state at the head of 10,000 veterans, and carried terror to the gates of Rome.

The haughty pontiff, though still inflexible and undaunted in himself, was forced to give way to the fears of the cardinals, and a truce was concluded for 40 days. Mean time the duke of Guise arriving with a supply of 20,000 French troops, Paul became more arrogant than ever, and banished all thoughts from his mind but those of war and revenge. The duke of Guise, however, who had precipitated his country into this war, chiefly from a desire of gaining a field where he might display his own talents, was able to perform nothing in Italy worthy of his former fame. He was obliged to abandon the siege of Civetella; he could not bring the duke of Alva to a general engagement; his army perished by diseases; and the Pope neglected to furnish the necessary reinforcements. He begged to be recalled; and France stood in need of his abilities.

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Philip, though willing to have avoided a rupture, was no sooner informed that Henry had violated the truce of Vaucelles, than he determined to act with such vigour, as should convince Europe that his father had not erred in resigning to him the reigns of government. He immediately assembled in the Low Countries a body of 50,000 men, and obtained a supply of 10,000 from England, which he had engaged in his quarrel; and as he was not ambitious of military fame, he gave the command of his army to Emanuel Philibert duke of Savoy, one of the greatest generals of that warlike age.

The duke of Savoy kept the enemy for some time in suspense with regard to his destination; at last he seemed to threaten Champagne; towards which the French drew all their troops; then turning suddenly to the right, he advanced by rapid marches into Picardy, and laid siege to St Quintin. It was deemed in those times a town of considerable strength; but the fortifications had been much neglected, and the garrison did not amount to a fifth part of the number requisite for its defence: it must therefore have surrendered in a few days, if the admiral de Coligny had not taken the gallant resolution of throwing himself into it with such a body of men as could be collected on a sudden. This he effected in spite of the enemy, breaking through their main body. The place, however, was closely invested; and the constable Montmorency, anxious to extricate his nephew out of that perilous situation, in which his zeal for the public had engaged him, as well as to save a town of such importance, rashly advanced to its relief with forces one half inferior to those of the enemy. His army was cut in pieces, and he himself made prisoner.

137 The French entirely defeated at St Quintin.

The cautious temper of Philip on this occasion saved France from devastation, if not ruin. The duke of Savoy proposed to overlook all inferior objects, and march speedily to Paris, which, in its present consternation, he could not have failed to make himself master of; but Philip, afraid of the consequences of such a bold enterprise, desired him to continue the siege of St Quintin, in order to secure a safe retreat in case of any disastrous event. The town, long and gallantly defended by Coligny, was at last taken by storm; but not till France was in a state of defence.

Philip was now sensible that he had lost an opportunity which could never be recalled, of distressing his enemy, and contented himself with reducing Horn and Catelet; which petty towns, together with St Quintin, were the sole fruits of one of the most decisive victories gained in the 16th century. The Catholic king, however, continued in high exultation on account of his success; and as all his passions were tinged with superstition, he vowed to build a church, a monastery, and a palace, in honour of St Laurence, on the day sacred to whose memory the battle of St Quintin had been fought. He accordingly laid the foundation of an edifice, in which all these were included, and which he continued to forward at vast expence, for 22 years. The same principle which dictated the vow directed the building. It was so formed as to resemble a gridiron—on which culinary instrument, according to the legendary tale,

Spain. St Laurence had ſuffered martyrdom. Such is the origin of the famous eſcurial near Madrid, the royal reſidence of the kings of Spain.

The firſt account of that fatal blow which France had received at St Quintin, was carried to Rome by the courier whom Henry had ſent to recal the duke of Guiſe. Paul remonſtrated warmly againſt the departure of the French army; but Guiſe's orders were peremptory. The arrogant pontiff therefore found it neceſſary to accommodate his conduct to the exigency of his affairs, and to employ the mediation of the Venetians, and of Coſmo de Medici, in order to obtain peace. The firſt overtures of this nature were eagerly liſtened to by the Catholic king, who ſtill doubted the juſtice of his cauſe, and conſidered it as his greateſt misfortune to be obliged to contend with the Pope. Paul agreed to renounce his league with France; and Philip ſtipulated on his part, that the duke of Alva ſhould repair in perſon to Rome, and after aſking pardon of the holy father in his own name and in that of his maſter, for having invaded the patrimony of the church, ſhould receive abſolution from that crime. Thus Paul, thro' the ſuperſtitious timidity of Philip, only finiſhed an unpropitious war not without any detriment to the apoſtolic ſee, but ſaw his conqueror humbled at his feet: and ſo exceſſive was the veneration of the Spaniards in that age for the papal character, that the duke of Alva, the proudeſt man perhaps of his time, and accuſtomed from his infancy to converſe with princes, acknowledged, that when he approached Paul, he was ſo much overawed, that his voice failed, and his preſence of mind forſook him.

138 Peace concluded.

139 Conſequences of the war in Italy.

But though this war, which at its commencement threatened mighty revolutions, was terminated without occaſioning any alteration in thoſe ſtates which were its immediate object, it produced effects of conſiderable conſequence in other parts of Italy. In order to detach Octavio Farneſe, duke of Parma, from the French intereſt, Philip reſtored to him the city of Placentia and its territory, which had been ſeized by Charles V. and he granted to Coſmo de Medici the inveſtiture of Sienna, as an equivalent for the ſums due to him. By theſe treaties, the balance of power among the Italian ſtates was poiſed with more equality, and rendered leſs variable than it had been ſince it received the firſt violent ſhock from the invaſion of Charles VIII. and Italy henceforth ceaſed to be the theatre on which the monarchs of Spain, France, and Germany, contended for fame and dominion. Their hoſtilities, excited by new objects, ſtained other regions of Europe with blood, and made other ſtates feel, in their turn, the miſeries of war.

140 The French unſucceſsful in the Low Countries.

The duke of Guiſe, who left Rome the ſame day that his adverſary the duke of Alva made his humiliating ſubmiſſion to the Pope, was received in France as the guardian angel of the kingdom. He was appointed lieutenant-general in chief, with a juriſdiction almoſt unlimited; and, eager to juſtify the extraordinary confidence which the king had repoſed in him, as well as to perform ſomething ſuitable to the high expectations of his countrymen, he undertook in winter the ſiege of Calais. Having taken that place, he next inveſted Thionville in the duchy of Luxembourg, one of the ſtrongeſt towns on the frontiers of the Netherlands; and forced it to capitulate after a ſiege of three weeks. But the advantages on this quarter were more than balanced by an event which happened in another part of the Low Countries. The mareſchal de Termes governor of Calais, who had penetrated into Flanders and taken Dunkirk, was totally routed near Gravelines, and taken priſoner by count Egmont. This diſaſter obliged the duke of Guiſe to relinquiſh all his other ſchemes, and haſten towards the frontiers of Picardy, that he might there oppoſe the progreſs of the enemy. Spain.

The eyes of all France were now turned towards the duke of Guiſe, as the only general on whoſe arms victory always attended, and in whoſe conduct as well as good fortune they could confide in every danger. His ſtrength was nearly equal to the duke of Savoy's, each commanding about 40,000 men. They encamped at the diſtance of a few leagues from one another; and the French and Spaniſh monarchs having joined their reſpective armies, it was expected that, after the viciſſitudes of war, a deciſive battle would at laſt determine which of the rivals ſhould take the aſcendant for the future in the affairs of Europe. But both monarchs, as if by agreement, ſtood on the defenſive; neither of them diſcovering any inclination, though each had it in his power, to reſt the deciſion of a point of ſuch importance on the iſſue of a ſingle battle.

141 Peace concluded between Henry and Philip.

During this ſtate of inaction, peace began to be mentioned in each camp, and both Henry and Philip diſcovered an equal diſpoſition to liſten to any overture that tended to re-eſtabliſh it. The private inclinations of both kings concurred with their political intereſts and the wiſhes of their people. Philip languiſhed to return to Spain, the place of his nativity; and peace only could enable him, either with decency or ſafety, to quit the Low Countries. Henry was now deſirous of being freed from the avocations of war, that he might have leiſure to turn the whole force of his government towards ſuppreſſing the opinions of the reformers, which were ſpreading with ſuch rapidity in Paris and the other great towns, that they began to grow formidable to the eſtabliſhed church. Court-intrigues conſpired with theſe public and avowed motives to haſten the negotiation, and the abbey of Cercamp was fixed on as the place of congreſs.

While Philip and Henry were making theſe advances towards a treaty which reſtored tranquillity to Europe, Charles V. whoſe ambition had ſo long diſturbed it, but who had been for ſome time dead to the world, ended his days in the monaſtery of St Juſtus in Eſtremadura, which he had choſen as the place of his retreat, as is particularly related under the article CHARLES V.

142 Death of Charles V.

After the death of Charles, the kingdom of Spain ſoon loſt great part of its conſequence. Though Charles had uſed all his intereſt to get his ſon Philip elected emperor of Germany, he had been totally diſappointed; and thus the grandeur of Philip II. never equalled that of his father. His dominions were alſo conſiderably abridged by his tyrannical behaviour in the Netherlands. In conſequence of this, the United Provinces revolted; and after a long and bloody war obtained their liberty*. In this quarrel Elizabeth of England took part againſt Philip, which brought on a war with Spain. The great loſſes he ſuſtained in theſe wars exhauſted the kingdom both of men and money, notwithſtanding the great ſums imported from America. Indeed, the diſcovery and conqueſt of that country hath much impoveriſhed, inſtead

143 Revolt of the United Provinces.

*See *United Provinces.*

Spain.

stead of enriching Spain; for thus the inhabitants have been rendered lazy and averse from every kind of manufacture or traffic, which only can be a durable source of riches and strength to any nation. The ruin of the kingdom in this respect, however, was completed by Philip III. who, at the instigation of the inquisition, and by the advice of his prime minister the duke of Lerma, expelled from the kingdom all the Moresco es or Moors, descendants of the ancient conquerors of Spain. Thirty days only were allowed them to prepare for their departure, and it was death to remain beyond that time. The reason for this barbarous decree was, that these people were still Mahometans in their hearts, though they conformed externally to the rites of Christianity, and thus might corrupt the true faith. The Moriscoes, however, chose themselves a king, and attempted to oppose the royal mandate; but, being almost entirely unprovided with arms, they were soon obliged to submit, and all banished the kingdom. By this violent and impolitic measure, Spain lost almost a million of industrious inhabitants; and as the kingdom was already depopulated by bloody wars, by repeated emigrations to America, and enervated by luxury, it now sank into a state of languor from whence it has never recovered.

144 Expulsion of the Moors, and its bad consequences to Spain.

In consequence of this languor, and the maladministration of the Spanish governors, Portugal, which had been reduced by Philip II. revolted, and has ever since been an independent kingdom ‡. However, the memory of what Spain once was, remained for a considerable time, and the power of that kingdom long continued to be feared after it had ceased to be powerful. In the time of queen Anne, a British army was seen for the first time in Spain, in order to support Charles of Austria against Philip the grandson of Louis XIV. The ill success of that attempt is related under the article BRITAIN, n° 342—359; and thus the crown of Spain fell to a branch of the house of Bourbon, in consequence of which the courts of France and Spain generally acted in the closest concert till the revolution, which at present astonishes Europe, put an end to monarchical government in the former country. The wars of these two courts with BRITAIN are related under that article and AMERICA; and these, with an unsuccessful attempt on Algiers, and the threatened war respecting *Nootka Sound* (see that article), constitute the most important part of the Spanish history till the deposition and murder of Louis XVI. of France. On that event Spain joined her forces to those of the Empire, Britain, and Prussia, to chastise the Convention, and prevent those democratical principles which had ruined France from being spread through the other nations of Europe. We cannot say that her exertions added much to the strength of the alliance; and being unable to defend herself against the furious inroads of the republican troops, she was glad to make a separate peace with the Convention. See REVOLUTION.

145 Revolt of Portugal, &c.

‡ See *Portugal*, n° 18, *et seq.*

146 Air and climate of Spain.

The air of Spain, during the months of June, July, and August, is excessively hot in the day-time; but the rest of the year it is pleasant and temperate. Even during the above months it is very cool in the shade; and so cold in the night, that it makes a traveller shiver; and in the day-time the violent heat continues only for about four or five hours. In the north, on the mountains, and near the sea-coast, the air is much less sultry in summer than in the south, especially in the lower parts of the country, and at a distance from the sea. It seldom rains here, except about the equinoxes: the frosts are very gentle towards the south; but on the mountains in the north and north-east the air is very sharp in winter.

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147 Soil and produce.

Though there are some sandy barren deserts in the south, and many barren mountains in the north, yet in the greater part of the country, particularly in the valleys and plains, the soil is good, producing a great variety of rich wines, oil, and fruits; such as oranges, lemons, prunes, citrons, almonds, raisins, dates, figs, chesnuts, pomegranates, capers, pears, and peaches; but not a sufficiency of grain, which is chiefly owing to the neglect of tillage. Wheat and barley are the most common grain; the former of which is said by some to be the best in Europe. There is not much flax, hemp, oats, or hay, in Spain: but there is plenty of honey, salt, fine wool, silk, and cotton; and, in some places, of rice and sugar-canes. Here also are abundance of mules, and, in some provinces, of horses, together with deer, wild-fowl, and other game, chamois and other goats, but few horned cattle. Wolves are almost the only wild beasts in the country. The herb kali, which is used in making salt, soap, and glass, grows in great plenty on the sea-shore. The wild bulls, used in their bull-fights, are bred in Andalusia. The seas about Spain are well stored with fish; among which is the anchovy, in the Mediterranean. We may guess at the number of sheep here by that of the shepherds, which is said to be about forty thousand. The sheep that bear the fine wool move regularly, every summer, from south to north, along the mountains, which yield a great variety of sweet herbs and plants, and return again towards winter. During this progress, large quantities of salt are distributed among them, and all possible care is taken both of their health and fleeces.

148 Mountains, minerals, &c.

The chief mountains are the Pyrenees, which stretch from the Mediterranean to the Atlantic Ocean, but not in a direct line, for near 200 miles: their breadth is, in some places, not less than 80. That called the *Pic de Midi* is of a prodigious height. Over these mountains there are only about five passages out of Spain into France, and these also narrow; even the valleys between the mountains are covered with thick and lofty woods. The other chains in Spain are the Sierra d'Occa, Sierra Molino, Sierra Moreno, and Sierra Novada or the snowy mountains. Near Gibraltar, opposite to Mount Abyla in Africa, stands the celebrated Mount Calpe: these were anciently called *Hercules's pillars*. The mountains yield great quantities of timber for shipping, which are conveyed by the Ebro and other rivers to the Mediterranean. According to the ancient and modern writers, they abound also with gold, silver, iron, lead, tin, cinnabar, quicksilver, alum, vitriol, copperas, lapis calaminaris, &c. besides gems, and mineral waters both hot and cold. The gold and silver mines are not worked at present, but those of iron are. The neglect of the former is owing partly to the indolence of the Spaniards, and partly to the gold and silver imported from America. Besides the rivers Minho, Douro, Tagus, Monda, Lima, and Guadiana, mentioned in Portugal, but which have their sources in Spain, the

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the moſt conſiderable are the Ebro, formerly *Iberus*, Guadalavier, anciently *Turia*, Guadalquiver or *Bætis*, Segura, and Xucar.

149 Religion.

The Spaniards are zealous Romaniſts. Nowhere is there more pomp, farce, and parade, in what regards religion; and nowhere leſs true Chriſtianity. Their zeal and their ſuperſtition exceed that of any other Roman Catholic country, unleſs perhaps we ſhould except Portugal. Nowhere did the inquiſition reign with greater terror; there being no ſubject who was not liable to be proſecuted by the *holy office*, as it is called; however, the powers of that tribunal are now greatly diminiſhed even in Spain. There are eight archbiſhops in Spain, ſeven in America, and one in Aſia at Manilla; each of which has his ſuffragan biſhops. The archbiſhop of Toledo is primate, chancellor of Caſtile, and, by virtue of his office, privy-counſellor. He is ſaid to have a revenue of 100,000l. Sterling *per annum*, or more. The king nominates all archbiſhops and biſhops; and ſince 1753 all ſmall benefices are alſo in his gift. He has alſo lately obtained a power to tax eccleſiaſtical poſſeſſions, according to his pleaſure and the exigency of affairs. Though the reſt of the nation is poor, the clergy are immenſely rich, and their revenues of all kinds very great. Moſt of the towns and eſtates belong to them, and are exempt from all public burdens; yet their avarice is inſatiable, eſpecially that of the Mendicant friars, though they profeſs poverty. Their commerce, which is free from all duties and impoſts, is alſo a rich fund to them. Though the Spaniards are naturally men of wit and of an elevated genius, yet little progreſs in the ſciences is to be expected from them, while the clergy uſe their utmoſt efforts to keep them in ignorance, branding all literary reſearches with the name of hereſy, and inveighing againſt the feats of the muſes as the ſchools of hell, where the devil teaches ſorcery. There are 22 univerſities, and ſeveral academies, in Spain; but ſo conſtituted, and under ſuch reſtrictions, that they can never attain to any meaſure of true learning. There are few printing-houſes in Spain; and moſt of the books in that language are publiſhed in other countries.

150 Trade and manufactures.

In regard to trade and manufactures, the Spaniards are far from making ſuch a figure as might be expected. Moſt of the laborious work in their huſbandry, manufactures, and handicrafts, is performed by the French, eſpecially in the two Caſtiles and the midland provinces, the natives being either too lazy or too proud to ſtoop to ſuch employments. By theſe means, the French uſually return with large fortunes to their own country. The chief manufactures of Spain are thoſe of ſilk, wool, iron, copper, and other hardwares; but theſe fall far ſhort of the flouriſhing condition to which they might be brought: hence a great part of the treaſures of America go to the foreign merchants, who ſupply them with goods for that part of the world. However, it is certain, that Spain, ſince it hath had princes of the houſe of Bourbon upon the throne, hath improved its revenues, increaſed its forces by ſea and land, and applied itſelf more than it did before to manufactures and huſbandry; having ſhaken off, in ſome meaſure, that idle indolent diſpoſition which rendered it ſo contemptible in the eyes of other nations; but it will be a long time before they will be able to ſupply the wants of their own country, and thoſe of America, in any great degree. Spain is extremely well ſituated for trade: but moſt of its produce is exported by foreigners, except what is carried to the Indies; and even with regard to that trade, they are little better than factors to the Engliſh, French, Dutch, and Italians. Smuggling, which was formerly carried to a great height, is now in a great meaſure ſuppreſſed. Since the year 1750, the exportation of ſilver hath been allowed on the payment of 3 *per cent.* From 1735 almoſt to 1756, the flotas and galleons were diſcontinued, and the trade to America carried on in regiſter-ſhips, which any merchant might ſend, on permiſſion obtained from the council of the Indies: but then the flotas and galleons were reſtored. The Aſſogue ſhips are two veſſels which carry quickſilver on the king's account to Vera Cruz. There is a company which has an excluſive grant for trading to the Caraccas; and another for trading to Porto Rico, the Bay of Honduras, the province of Guatimala and Hiſpaniola; but the Spaniſh part of the laſt, it is ſaid, hath been lately ceded to the French. One ſhip, and ſometimes two, ſails annually from Manilla, in the iſland of Luconia, one of the Philippines, for Acapulco in Mexico: her cargo, which belongs to the convents, conſiſts of the principal commodities of that part of the world; but the return from Acapulco is for the moſt part made in money, and amounts to a vaſt ſum, as appeared from the treaſure found on board the Acapulco ſhip taken by Lord Anſon. In return for the manufactures ſent to America, the Spaniards receive gold, ſilver, cochineal, indigo, the cocoa or chocolate nut, logwood and other dyeing woods, ſugar, tobacco, ſnuff, and other productions of that part of the world; ſupplying moſt part of Europe and Aſia with the ſilver which they bring from thence in their galleons. In the time of the Moors and Goths, this kingdom was exceedingly populous. It is ſaid to have then contained between twenty and thirty millions; whereas now it does not contain above nine: and this, among other cauſes, is owing to the pride and lazineſs of the inhabitants, want of manufactures and good regulations, neglect of the mines and agriculture, the expulſion of the Moors, the peopling of America, heavy taxes, the great number of convents, exceſſive venery, and the conſequent infecundity of both ſexes. Their debauchery and ſterility are partly occaſioned by their way of living; for they make great uſe of ſpices, and drink a great deal of chocolate, and ſtrong wine mixed with brandy. The cauſes aſſigned for the want of people in Spain will account in ſome meaſure for its poverty; notwithſtanding it is computed that it receives one year with another, ſetting aſide other ſums, above 26 millions of pieces of eight, in regiſtered gold and ſilver. As moſt of the manufactures that are ſent to America are furniſhed by Britain, France, Italy, and Holland, ſo a great part of the treaſure brought home by the galleons is paid to the merchants of thoſe nations.

151 Conſtitution and government.

The conſtitution of Spain is at preſent an abſolute hereditary monarchy, where the females inherit in default of the males. The king, in his title, enumerates moſt of the provinces and particular parts of the dominions he has been or is poſſeſſed of. In ſpeaking of him, he is commonly called his *Catholic Majeſty*, or the *Catholic King*. The hereditary prince is commonly ſtyled *Prince of Aſturias*, and the other royal children *Infants*. The kings of Spain are never crowned; they ſeem

Spain. seem to have a power to diſpoſe of the crown to what branch of the royal family they pleaſe. For the adminiſtration of the government and of juſtice, here are ſeveral councils and tribunals; as the junto or cabinet-council, the privy-council, the council of war, the council of Caſtile, the council of the inquiſition, the council of finances, the council of the Indies, the ſeven courts of royal audiences, &c.

Bourgoanne's Travels in Spain. The general hiſtory of Spain proves how great an influence the Cortes had in former times in the moſt important affairs of government; ſuch as war or peace, and the levying of taxes. But during a long courſe of years they have not been aſſembled, except for the ſake of form; and the ſovereigns, without violence, or formally rejecting their intervention, have found means to elude their authority. They promulgate from the throne certain ordinances under the name of *Pragmatics*, the preambles of which give us to underſtand, that they claim the ſame authority as if they had been publiſhed in the aſſembly of the Cortes; who are never convoked but at the acceſſion of a new monarch, to adminiſter to him an oath in the name of the nation, and to ſwear fidelity to him. As this event happened ſo lately as the month of September 1789, when the preſent king of Spain received the homage of all his ſubjects in the church of St Jerome at Madrid, it may not be unacceptable to give an account of the uſual mode of aſſembling them.

"On this occaſion letters of convocation are ſent to all the Grandees; to all perſons bearing titles of Caſtile; to all the prelates; and to every city which has a right to ſend deputies to the Cortes. The two firſt claſſes repreſent the nobility; the prieſts fit in the name of the clergy; and the cities, which depute one of their magiſtrates, repreſent the people." Except on the above-mentioned occaſion, the Cortes of the whole kingdom have been aſſembled but twice during the preſent century, and only once upon public buſineſs, in the year 1713, when Philip V. convoked them to give their approbation to the Pragmatic Sanction, which changed the order of ſucceſſion to the throne. They are ſtill conſulted, for the ſake of form, in certain caſes; but then, the members of which they are compoſed correſpond with each other without aſſembling. At their breaking up in 1713, it was regulated, that they ſhould be repreſented by a permanent committee, whoſe office it ſhould be to watch over the adminiſtration of that part of the taxes known by the name of *Millones*, and which had been granted under Philip II. with the formal conſent of the Cortes, upon certain conditions, which the monarch ſwore to obſerve. They retained the adminiſtration of theſe impoſts until the year 1718, when cardinal Alberoni, whoſe ardent and imperious genius was irritated at ſuch ſhackles, transferred it to the hands of the ſovereign. From that time, the aſſemblies of the deputies of the kingdom have received no more of the revenues of the ſtate than is neceſſary to pay the ſalaries and defray the expences of the members. Theſe are eight in number, and are choſen in the following manner: All the provinces of Caſtile unite to nominate ſix; Catalonia and Majorca appoint one; and the regencies of Valentia and Aragon elect the eighth. Theſe deputies hold their places ſix years, at the end of which a new election takes place in the ſame manner. As a relict of their ancient rights, they ſtill retain the privilege of being, by virtue of their places, members of the council of finances, by which the ſovereign communicates to the nation the neceſſity of levying any new tax; and the approbation they are ſuppoſed to give to the royal reſolution, is a ſhadow of the conſent of the Cortes, without which taxes could not formerly be either levied or augmented. But it is eaſy to perceive how feeble this rampart of liberty muſt be, which is only formed of a ſmall number of citizens, who poſſeſs but little real power; are under the controul of government, from which they expect favours and preferments; and who, after all, repreſent the moſt numerous indeed, but leaſt reſpected, part of the nation. The provinces of Biſcay and Navarre, which have aſſemblies and particular privileges, ſend alſo, on ſome occaſions, deputies to the throne; but they do not make a part of the body of the deputies of the kingdom, and their conſtituents fix at pleaſure the object and duration of their temporary miſſion. Spain.

The adminiſtration of Spain is divided into ſix principal departments. The miniſter for foreign affairs is in many reſpects the directing miniſter, and receives, as a mark of diſtinction, the title of ſecretary of ſtate. The miniſter of war has but a circumſcribed authority. He is preſident of the council of war, which is rather a tribunal than a board of adminiſtration; but the inſpectors of the infantry, and thoſe of the cavalry, dragoons, and provincial regiments, draw up a ſtatement of whatever relates to the corps of which they have the direction; and the miniſter at war has only to preſent the memorials they give in to the king. The marine miniſter has no aſſociates. The chiefs of the three departments of Ferrol, Carthagena, and Cadiz, and inſpectors of the marine, are named by the king, on the repreſentation of the miniſter; but the marine ordinances prepared by him alone, require only the ſanction of the king. The miniſter of the finances ſhould properly be under the inſpection of the ſuperintendant-general of that department; but theſe two offices were ſome time ſince united, and will probably be ſo continued; for the ſeparation of them would multiply, without neceſſity, the ſprings of government; and the intereſts of the ſtate require that they ſhould be ſimplified as much as permanent forms, thoſe ſacred bulwarks of juſtice and property, will admit.

The higher nobility conſiſt of counts, marquiſes, and dukes. The grandees, who have precedence of all others, next the king and princes of the blood, are named out of theſe. They have the privilege of being covered in the king's preſence, who ſtyles them in his letters *Illuſtrious*; and in ſpeaking to them or of them, *their Eminences*: but there are others beſide the grandees who are covered in the king's preſence; as cardinals, nuncios, archbiſhops, the grand prior of Caſtile and the grand prior of Malta, the generals of the orders of St Dominic and St Francis, ambaſſadors of crowned heads, the knights of the golden fleece, and of the three military orders of St James, Calatrava, and Alcantara, when the king aſſiſts at their reſpective chapters in quality of grandmaſter. No grandee can be apprehended for any crime but by the expreſs order of the king; and they have many other privileges beſides theſe. The inferior nobility ſtyle themſelves *Cavalleros* and *Hidalgos*.

Of the orders in Spain, that of the golden fleece is the

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the principal; which was instituted in 1430 by Philip the good duke of Burgundy, and is common now to the kings of Spain and the house of Austria. The order of St Jago de Compostella was instituted in the year 1175 by Ferdinand II. king of Leon. The order of Calatrava was founded by Sancho III. of Castile. The order of Alcantara owes its institution to Ferdinand II. king of Leon. The three last orders have large commanderies or estates annexed to them. The masters of them were once so powerful, that they disputed the king's authority over them; whereupon the king procured those masterships to be conferred on himself by the Pope, that they might no longer assume an independency of the state. The knights of these three orders are esteemed noblemen.

152 Orders of knighthood.

153 Revenues.

In the last century, the revenues of Spain amounted to 32 or 33 millions of livres; but afterwards they were so reduced, that they did not exceed seven or eight millions. At present, the revenues of the crown arising in Spain are computed at five millions Sterling *per annum*, besides what arises from America. The silver mines there are inexhaustible; and of the produce of these a fifth belongs to the king. The taxes in Spain are numerous and heavy. The land forces, in time of peace, are computed at about 80,000; and in time of war, must be much more numerous, Their navy at present cannot be ascertained.

154 Language.

The language of this country, especially that spoken in Castile, which is by far the purest, approaches the nearest to the Latin of any language in Europe, mixed with Arabic words and terminations introduced by the Moors. In some provinces, the vulgar tongue is a dialect of the old French, or rather Gascon, which is little understood in the others. In Biscay, the language is said to be a dialect of the Gothic or Celtic, and to have some analogy with the Welch and Irish. As to what regards the character of the Spaniards, they do not want either an inclination or capacity for the sciences; but have hardly an opportunity of acquiring any true learning or knowledge, at least in their schools and universities. They are admired for their secrecy, constancy, gravity, patience in adversity, and loyalty. They are also said to be true to their word, great enemies to lying, and so nice and jealous in point of honour, that they will stick at nothing to wipe off any stain that is cast upon it. Among their vices and defects are reckoned their pride and contempt of foreigners, their indolence, laziness, lust, bigotry, and credulity in believing the feigned miracles and legends of their monks. They are also said to be extremely passionate, jealous, and vindictive; and are noted, above any other European nation, for despising and neglecting agriculture, arts, and manufactures.

155 Some directions for travelling in Spain.

We will here subjoin some directions for travelling in Spain by Mr Townsend, a late respectable traveller; as they will enable the reader to form a more distinct notion of the state of that country than he could obtain from general description.

Townsend's Travels, vol. i.

"To travel commodiously in Spain, a man should have a good constitution, two good servants, letters of credit for the principal cities, and a proper introduction to the best families, both of the native inhabitants and of strangers settled in the country.

"The language will be easily acquired.

"His servants should be a Spaniard and a Swiss; of which one should be sufficiently acquainted with the art of cooking, and with the superior art of providing for the journey; which implies a perfect knowledge of the country though which he is to pass, that he may secure a stock of wine, bread, and meat, in places where these excel, and such a stock as may be sufficient to carry him through the districts in which these are not to be obtained. For himself, his servants, and his baggage, he should purchase three strong mules, able to support the load which is to be put upon them. In his baggage he should have sheets, a matrass, a blanket, and a quilt, a table-cloth, knives, forks, and spoons, with a copper vessel sufficiently capacious to boil his meat. This should be furnished with a cover and lock. Each of the servants should have a gun slung by the side of his mule.

Spain, Spalatro.

"To travel as an economist in Spain, a man must be contented to take his chance for conveyance, and either go by the post, wherever it is established; or join with officers, going to their various stations; to hire a coach, or quietly resign himself to a calash, a calasine, a horse, a mule, or a borrico. This last is the most convenient for the purpose of crossing the country, or of wandering among the mountains. If he is to traverse any district infested by banditti, it will be safe for him to go by the common carriers, in which case he will be mounted on a good mule, and take the place which would have been occupied by some bale of goods. Any one, who is fond of botany, for short excursions, will make choice of a borrico. This is always to be had when, as in some villages, neither horse nor mule are to be obtained. I have used this honourable appellation for the most patient of all animals, because I would not shock the delicacy of a young traveller, by telling him, at his first setting out, that he may sometimes find himself under the necessity of riding upon an ass. He must, however, know, for his consolation, that an ass does not appear so contemptible in Spain as in the colder regions of the north.

"The best time for him to begin this expedition is in autumn, when he may go by Bayonne, Burgos, Valladolid, and Segovia, hastening to the court at St Ildefonso. Here he is to procure letters for the chief cities in Spain. On these will depend the whole pleasure of his excursion. During the winter he may see all the south of Spain, Toledo, Cordova, Seville, Cadiz, Gibraltar, Malaga, Granada, Carthagena, Murcia, Alicant, Valencia, and Barcelona. Returning by Zaragoza to Aranjuez in the spring, he may follow the Merino flock to the mountains of the north, whilst the country, on which he has turned his back, is rendered unfit for travelling, by the dissolving heats, by want of provisions, and by malignant fevers. This season will be best employed in Galicia, the Asturias, and the provinces of Biscay, taking Salamanca and Leon in the way."

New Spain. See Mexico.

SPALATRO, or Spalatto, a rich, populous, and strong town of the republic of Venice, capital of Venetian Dalmatia, with a good harbour and an archbishop's see. Here are the ruins of the palace of Diocletian, of which the late Mr Robert Adam published in 1764 a splendid account, enriched with 71 folio plates. In 1784, Spalatro was nearly depopulated by the plague. It is strong by situation, being built on a peninsula, which is joined to Terra Firma by a neck of land half a mile over. It is seated on the Gulf of Venice, 35 miles

Span || Spar.

south-east of Sebenico, and 102 north-west of Ragusa. E. Long. 17. 31. N. Lat. 44. 4.

SPAN, a measure taken from the space between the thumb and the tip of the little finger when both are stretched out. The span is estimated at three hand's breadths or nine inches.

SPANDRELL, the solid work on each haunch of an arch, to keep it from spreading.

SPANHEIM (Ezekiel), a learned writer in the 17th century, was born at Geneva in 1629; and in 1642 went to Leyden to study. Here he distinguished himself to great advantage; and his reputation spreading, Charles Louis elector palatine sent for him to be tutor to his only son. This task our author discharged to the entire satisfaction of the elector; by whom he was also employed in divers negotiations at foreign courts. He afterwards entered into the service of the elector of Brandenburg, who in 1680 sent him envoy-extraordinary to the court of France, and soon after made him a minister of state. After the peace of Ryswic, he was again sent on an embassy to France, where he continued from the year 1697 to 1702. The elector of Brandenburg having during that interval assumed the title of *King of Prussia*, conferred on him the title and dignity of a baron. In 1702 he left France; and went ambassador to England, where he had been several times. Here he died in 1710, aged 81 years. It is surprising, that in discharging the duties of a public minister with so much exactness, and amidst so many different journeys, he could find time enough to write the several books published by him. It may be said of him, that he acquitted himself in his negotiations like a person who had nothing else in his thoughts; and that he wrote like a man who had spent his whole time in his study. The principal of his works are, 1. *De præstantia et usu numismatum antiquorum;* the best edition of which is in two volumes folio. 2. Several letters or dissertations on scarce and curious medals. 3. A preface and notes to the edition of the emperor Julian's works, printed at Leipsic in 1696, folio.

SPANIEL, in zoology. See CANIS.

SPAR, in mineralogy, a name given to those earths which break easily into rhomboidal, cubical, or laminated fragments with polished surfaces. As the term *spar* is thus applied to stones of different kinds, without any regard to the ingredients of which they are composed, some additional term must be used to express the constituent parts as well as the figure; for instance, calcareous spar, gypseous spar, &c. The spars found in Britain and Ireland are of four different species; opaque, refracting, diaphanous, and stalactitical. 1. The opaque spar is rhomboidal, hexangular, and triangular, of various colours, and is found in mines in Wales, Derbyshire, &c. and at Ovens near Cork. 2. The refracting spar is rhomboidal, shows objects seen through it double, and sometimes 8, 12, or 16 images at once. It is frequent in the lead mines of Derbyshire, Yorkshire, &c. 3. Diaphanous spar is rhomboidal, triangular, hexangular, pyramidal or columnar; and is found in mines, quarries, and caverns, in many different places. 4. Stalactitical spar, icicle or drop-stone, is formed by the running or dropping of water, containing a large proportion of calcareous earth. It is opaque, generally laminated, but from accidental circumstances assumes various forms. It occurs at Knaresborough in Yorkshire, and at Ovens near Cork.

Spar, Spargaanium.

A new species of spar has lately been found in the East Indies, which, from its extreme hardness, approaching to that of a diamond, is called *adamantine spar*. It was discovered by Dr Black of Edinburgh to be a distinct species. Happening one day to visit a lapidary, it was shown to him among other specimens as a stone that was used in the East Indies for polishing gems, and grinding other hard substances. Dr Black immediately singled out a specimen which he sent to Mr Greville, who requested M. Klaproth to analyze it.

There are two varieties of this spar; one of them comes from China, and crystallizes in hexagonal prisms without pyramids, the length of the sides varying from six to twelve lines; their breadth being about nine, of a grey colour with different shades. Though the entire pieces are opaque, the thin laminæ are transparent, and when broken, its surface appears slightly striated. Its crystals are covered with a very fine and strongly adhering crust, composed of scales of silvery mica, mixed with particles of red feld-spar. Sometimes the surface has martial pyrites or yellow sulphuret of iron adhering to it. Its hardness is so great, that it not only cuts glass as easily as the diamond, but even scratches rock-crystal and other very hard stones. Its specific gravity is to that of water as 3710 to 1000. Sometimes it contains crystallized grains of magnetic oxyd of iron, which may be separated from the stone when pulverized by means of the loadstone.

The other kind found in Hindostan is of a whiter colour, and of a more laminated texture than the former: the grains of iron contained in it are likewise of a smaller size than those of the former; they are not diffused through its substance, but only adhere to its surface.

This spar is exceedingly difficult to analyze. To do so, M. Klaproth was obliged to melt it no less than 12 times with 15 parts of soda or mineral alkali, in a silver crucible; the heat being each time continued for five hours as strong as the crucible could bear. After each fusion the mass was softened by boiling distilled water, filtering and precipitating by acids the small quantity of earth which the alkali had dissolved; and lastly, that portion which had not been decomposed was digested at different times with concentrated and boiling acids. By this tedious process he at length found, that the spar consisted of alumine and another kind of earth, in the proportion of 2 to 1, the nature of which is not understood. It is not siliceous earth, as it does not combine with fixed alkalis in a melting heat; and for want of opportunities to make a sufficient number of experiments, our author was unable to determine whether it be a sixth simple earth, or a composition of two or more earths which he was not able to separate.

From a letter of M. Morveau to Mr Crell, it appears that this stone is also found in France. A small bit of this was tried by him in presence of Mr Wedgewood, and he found that its specific gravity was superior to the spar of China, being no less than 4.1803, and the true adamantine spar of China gave 3.8222.

SPARGANIUM, BUR-REED, in botany: A genus of plants belonging to the class of *monœcia*, and to the order of *triandria;* and in the natural system ranged under the 3d order, *Calamariæ*. The amentum of the male

Sparmannia || Sparta.

male flower is roundiſh, the calyx is triphyllous, and there is no corolla. The amentum of the female flower reſembles that of the male. The ſtigma is bifid; the fruit is a dry berry containing one ſeed. There are two ſpecies, the erectum and natans, both of them natives of Great Britain and Ireland. 1. The *Erectum*, great bur-reed, has a ſtem two or three feet high, erect, firm and branched; the lower leaves are triangular, the upper ones plain. The male heads are much ſmaller than the female. This ſpecies flowers in July, and is frequent on the banks of rivers and lakes and near ſtagnant waters. 2. The *Natans*, floating or little bur-reed, has a ſtalk about two feet long. The leaves float, are about a foot long, one fourth of an inch wide at the baſe, and one-eighth in the middle, and end in a point. The male ſphœrules are generally three, and all ſeſſile; the female are commonly three, the two lower being ſupported on peduncles, the uppermoſt ſeſſile. It flowers in July, and grows in pools and lakes, but is rare.

SPARMANNIA, in botany; a genus of plants belonging to the claſs of *polyandria*, and to the order of *monogynia*. The corolla conſiſts of four petals, and is bent back; the nectaria are numerous, and ſwell a little; the calyx is quadriphyllous; the capſule is angulated, quinquelocular and echinated. There is only one ſpecies, the *Africana*.

SPARROW, in ornithology. See FRINGILLA.

Sparrow-Hawk, in ornithology. See FALCO.

Sparrow-Graſs. See ASPARAGUS.

SPARRY-ACID. See *Fluor-Acid*, and CHEMISTRY-*Index*.

SPARTA, or LACEDÆMON, the capital of the country of Laconia in Greece, an ancient and moſt renowned ſtate, the inhabitants of which have been in all ages celebrated for the ſingularity of their laws and character.—The hiſtory of Sparta for many ages is entirely fabulous; and the authentic accounts commence only with the celebrated lawgiver Lycurgus, who flouriſhed about 870 B. C. See the article LYCURGUS.

1 The hiſtory of Sparta moſtly fabulous till the time of Lycurgus.

After his death, the firſt important tranſaction which we find mentioned in the Spartan hiſtory is the Meſſenian war, which commenced in the year 752 B. C. and ended in the total reduction of the Meſſenian territory, as related under the article MESSENIA. During this period, according to ſome authors, a great change took place in the government of Sparta. This was the creation of the ephori, which is aſcribed to one of the kings named *Theopompus*. This man perceiving that there was a neceſſity for leaving magiſtrates to execute the laws, when the kings were obliged to be in the field, appointed the magiſtrates above mentioned, who afterwards made ſo great a figure in the ſtate (ſee EPHORI). One great privilege of the ephori was, that they did not riſe up at the preſence of the kings, as all other magiſtrates did: another was, that if the kings offended againſt the laws, the ephori took cognizance of the offence, and inflicted a ſuitable puniſhment. From the firſt election of the ephori, the year was denominated, as at Athens, from the firſt election of the archons.

The conqueſt of Meſſenia gave Sparta the ſuperiority over the reſt of the ſtates, excepting only that of Athens, which for a long time continued to be a very troubleſome rival; but the conteſts between theſe two rival ſtates have been ſo fully related under the article ATTICA, that nothing more is requiſite to be added in the place.—In the time of the Perſian war, Leonidas the Spartan king diſtinguiſhed himſelf in ſuch a manner, as to become the admiration not only of that but of every ſucceeding age. It being reſolved in a general council to defend the ſtraits of Thermopylæ againſt the Perſians, 7000§ foot were put under the command of Leonidas; of whom, however, only 300 were Spartans. Leonidas did not think it practicable to defend the paſs againſt ſuch multitudes as the Perſian king commanded; and therefore privately told his friends, that his deſign was to devote himſelf to death for his country.

Sparta.

2 Leonidas undertakes to defend the ſtraits of Thermopylæ againſt the Perſians.

§ See *Anacharſis's Travels*, vol. i. p. 468.

Xerxes advancing near the ſtraits, was ſtrangely ſurpriſed to find that the Greeks were reſolved to diſpute his paſſage; for he had always flattered himſelf, that on his approach they would betake themſelves to flight, and not attempt to oppoſe his innumerable forces. However, Xerxes ſtill entertaining ſome hopes of their flight, waited four days without undertaking any thing, on purpoſe to give them time to retreat. During this time, he uſed his utmoſt endeavours to gain and corrupt Leonidas, promiſing to make him maſter of all Greece if he would come over to his intereſt. His offers being rejected with contempt and indignation, the king ordered him by an herald to deliver up his arms. Leonidas, in a ſtyle and with a ſpirit truly laconical, anſwered, "Come thyſelf, and take them." Xerxes, at this reply, tranſported with rage, commanded the Medes and Ciſſians to march againſt them, take them all alive, and bring them to him in fetters. The Medes, not able to ſtand the ſhock of the Greeks, ſoon betook themſelves to flight: and in their room Hydarnes was ordered to advance with that body which was called *Immortal*, and conſiſted of 10,000 choſen men; but when theſe came to cloſe with the Greeks, they ſucceeded no better than the Medes and Ciſſians, being obliged to retire with great ſlaughter. The next day the Perſians, reflecting on the ſmall number of their enemies, and ſuppoſing ſo many of them to be wounded that they could not poſſibly maintain a ſecond fight, reſolved to make another attempt; but could not by any efforts make the Greeks give way: on the contrary, they were themſelves put to a ſhameful flight. The valour of the Greeks exerted itſelf on this occaſion in a manner ſo extraordinary, that Xerxes is ſaid to have three times leaped from his throne, apprehending the entire deſtruction of his army.

3 The Perſians repulſed with great ſlaughter.

Xerxes having loſt all hopes of forcing his way through troops that were determined to conquer or die, was extremely perplexed and doubtful what meaſures he ſhould take in this poſture of affairs; when one Epialtes, in expectation of a great reward, came to him, and diſcovered a ſecret paſſage to the top of the hill which overlooked and commanded the Spartan forces. The king immediately ordered Hydarnes thither with his ſelect body of 10,000 Perſians; who marching all night, arrived at break of day, and poſſeſſed themſelves of that advantageous poſt. The Phocæans, who defended this paſs, being overpowered by the enemy's numbers, retired with precipitation to the very top of the mountain, prepared to die gallantly. But Hydarnes neglecting to purſue them, marched down the mountain with all poſſible expedition, in order to attack thoſe who defended the ſtraits in the rear. Leonidas being now appriſed that it was impoſſible to bear up againſt the enemy, obliged the reſt of his allies to retire: but he ſtaid himſelf, with the Theſpians, Thebans, and 300

4 They are ſhown a way over the hill to ſurround the Greeks.

5 Lace-

Sparta. Lacedemonians, all resolved to die with their leader; who being told by the oracle, that either Sparta should be destroyed or the king lose his life, determined without the least hesitation to sacrifice himself for his country. The Thebans indeed remained against their inclination, being detained by Leonidas as hostages; for they were suspected to favour the Persians. The Thespians, with their leader Demophilus, could not by any means be prevailed upon to abandon Leonidas and the Spartans. The augur Megistias, who had foretold the event of this enterprize, being pressed by Leonidas to retire, sent home his only son; but remained himself, and died by Leonidas. Those who staid did not feed themselves with any hopes of conquering or escaping, but looked upon Thermopylæ as their graves; and when Leonidas, exhorting them to take some nourishment, said, that they should all sup together with Pluto, with one accord they set up a shout of joy, as if they had been invited to a banquet.

Xerxes, after pouring out a libation at the rising of the sun, began to move with the whole body of his army, as he had been advised by Epialtes. Upon their approach, Leonidas advanced to the broadest part of the passage, and fell upon the enemy with such undaunted courage and resolution, that the Persian officers were obliged to stand behind the divisions they commanded, in order to prevent the flight of their men. Great numbers of the enemy falling into the sea, were drowned; others were trampled under foot by their own men, and a great many killed by the Greeks; who knowing they could not avoid death upon the arrival of those who were advancing to fall upon their rear, exerted their utmost efforts. In this action fell the brave Leonidas; which Abrocomes and Hyperanthes, two of the brothers of Xerxes, observing, advanced with great resolution to seize his body, and carry it in triumph to Xerxes. But the Lacedemonians, more eager to defend it than their own lives, repulsed the enemy four times, killed both the brothers of Xerxes, with many other commanders of distinction, and rescued the body of their beloved general out of the enemy's hands. But in the mean time, the army that was led by the treacherous Epialtes, advancing to attack their rear, they retired to the narrowest place of the passage, and drawing all together except the Thebans, posted themselves on a rising ground. In this place they made head against the Persians, who poured in upon them on all sides, till at length, not vanquished, but oppressed and overwhelmed by numbers, they all fell, except one who escaped to Sparta, where he was treated as a coward and traitor to his country; but afterwards made a glorious reparation in the battle of Platæa, where he distinguished himself in an extraordinary manner. Some time after, a magnificent monument was erected at Thermopylæ, in honour of those brave defenders of Greece, with two inscriptions; the one general, and relating to all those who died on this occasion, importing, that the Greeks of Peloponnesus, to the number only of 4000, made head against the Persian army, consisting of 3,000,000. The other related to the Spartans in particular, and was composed by the poet Simonides, to this purport: "Go, passenger, and acquaint the Spartans that we died here in obedience to their just commands." At those tombs a funeral oration was yearly pronounced in honour of the dead heroes, and public games performed with great solemnity, wherein none but the Lacedemonians and Thespians had any share, to show that they alone were concerned in the glorious defence of Thermopylæ.

5 Leonidas killed with all his men.

Sparta. 6 A dreadful earthquake in Sparta.

At the end of the 77th Olympiad, a most dreadful earthquake happened at Sparta, in which, according to Diodorus, 20,000 persons lost their lives; and Plutarch tells us, that only five houses were left standing in the whole city. On this occasion the Helotes or slaves, whom the Spartans had all along treated with the utmost cruelty, attempted to revenge themselves, by taking up arms, and marching directly to the ruins of the city, in hopes of cutting off at once those who had escaped from the earthquake. But in this they were prevented by the prudence of the Spartan king Archidamus; for he, observing that the citizens were more desirous of preserving their effects than taking care of their own lives, caused an alarm to be sounded, as if he had known that an enemy was at hand. On this the citizens armed themselves in haste with such weapons as they could come at; and having marched a little way from the city, met the Helotes, whom they soon compelled to retire. The latter, however, knowing that they had now no mercy to expect from those who had already treated them with such cruelty, resolved to defend themselves to the last. Having therefore seized a sea-port town in Messenia, they from thence made such incursions into the Spartan territories, that they compelled those imperious masters to ask assistance from the Athenians. This was immediately granted; but when the Spartans saw that the skill of the Athenians in besieging towns was much greater than their own, they became jealous, and dismissed their allies, telling them, that they had now no farther occasion for their services. On this the Athenians left them in disgust; and as the Helotes and Messenians did not choose to come to an engagement with a Spartan army in the field, but took shelter in their fortified places, the war was protracted for ten years and upwards. At last the Helotes were reduced to their former misery; and the Messenians were obliged to leave Peloponnesus, on pain of being made slaves also. These poor people were then received by the Athenians, who granted them Naupactus for their residence, and afterwards brought them back to a part of their own country, from whence in the course of the Peloponnesian war they had driven the Spartans.

7 War with the Helotes.

8 With the Athenians and Persians.

In the year 431 B. C. the Peloponnesian war commenced; of which a full account has been given under the article ATTICA, n° 116—165. It ended most unfortunately for the Athenians; their city being taken and dismantled, as related in the article above-mentioned. Thus were the Spartans raised to the highest pitch of glory; and, in the reign of Agesilaus, they seemed to be on the point of subverting the Persian empire, as related under the article PERSIA, n° 34. But here their good fortune and their views of empire were suddenly checked. Agesilaus had carried on the war in Asia with the greatest success; and as he would hearken to no terms of accommodation, a Persian governor named *Tithraustes*, having first attempted in vain to bribe the king, dispatched Timocrates the Rhodian with 50 talents into Greece, in order to try whether he could there meet with any persons less incorruptible than the Spartan monarch. This agent found many who inclined to accept his offers; particularly in Thebes, Co-

Sparta.

9
A general combination againſt Sparta.

rinth, and Argos. By diſtributing the money in a proper manner, he inflamed the inhabitants of theſe three cities againſt the Spartans; and of all others the Thebans came into his terms with the greateſt readineſs. They ſaw that their antagoniſts would not of their own accord break with any of the ſtates of Greece, and did not chooſe to begin the war themſelves, becauſe the chiefs of the Perſian faction were unwilling to be accountable for the event. For this reaſon they perſuaded the Locrians to invade a ſmall diſtrict which lay in diſpute betwixt the Phocians and themſelves. On this the Phocians invaded Locris; the Locrians applied to the Thebans, and the Phocians to the Spartans. The latter were glad of an opportunity of breaking with the Thebans; but met with a much warmer reception than they expected. Their old general Lyſander, who had reduced Athens, was defeated and killed, with the loſs of 1000 men: on which diſaſter Ageſilaus was recalled, and obliged to relinquiſh all hopes of conquering the Perſians. His return changed the fortune of the war ſo much, that all the ſtates began to grow weary of a conteſt from which nobody derived any advantage except the king of Perſia. In a ſhort time a treaty was concluded, known in hiſtory by the name of the *peace of Antalcidas*. The terms of this treaty were highly diſadvantageous and diſhonourable to the Greeks§; for even the Spartans, though ſucceſsful in Greece, had loſt a great battle at ſea with the Perſian fleet under Conon the Athenian, which entirely broke their power in Aſia.

10
Peace of Antalcidas.

§ See *Perſia*, n° 37.

By the peace of Antalcidas, the government of Bœotia was taken from the Thebans, which they had for a long time enjoyed; and by this they were ſo much provoked, that at firſt they abſolutely refuſed to accede to the treaty; but as Ageſilaus made great preparations to invade them, they thought proper at laſt to comply.

11
Hoſtilities recommenced.

However, it was not long before a new war commenced, which threatened the total ſubverſion of the Spartan ſtate. As, by the peace of Antalcidas, the king of Perſia had in a manner guaranteed the ſovereignty of Greece to Sparta, this republic very ſoon began to exerciſe its power to the utmoſt extent. The Mantineans were the firſt who felt the weigh of their reſentment, although they had been their allies and confederates. In order to have a pretence for making war againſt them, they commanded them to quit their city, and to retire into five old villages which, they ſaid, had ſerved their forefathers, and where they would live in peace themſelves, and give no umbrage to their neighbours. This being refuſed, an army was ſent againſt them to beſiege their city. The ſiege was continued through the ſummer with very little ſucceſs on the part of the Spartans; but having during the winter ſeaſon dammed up the river on which the city ſtood, the water roſe to ſuch an height, as either to overflow or throw down the houſes; which compelled the Mantineans to ſubmit to the terms preſcribed to them, and to retire into the old villages. The Spartan vengeance fell next on the Phliaſians and Olynthians, whom they forced to come into ſuch meaſures as they thought proper. After this they fell on the Thebans; and, by attempting to ſeize on the Piræum, drew the Athenians alſo into the quarrel. But here their career was ſtopped: the Thebans had been taught the art of war by Chabrias the Athenian; ſo that even Ageſilaus himſelf took the command of the Spartan army in vain. At ſea they were defeated by Timotheus the ſon of Conon; and by land the battle of Leuctra put an end to the ſuperiority which Sparta had held over Greece for near 500 years. See LEUCTRA.

Sparta.

12
The power of Sparta entirely broken.

After this dreadful defeat, the Spartans had occaſion to exert all their courage and reſolution. The women and neareſt relations of thoſe who were killed in battle, inſtead of ſpending their time in lamentations, ſhook each other by the hand, while the relations of thoſe who had eſcaped from the battle hid themſelves among the women; or if they were obliged to go abroad, they appeared in tattered clothes, with their arms folded, and their eyes fixed on the ground. It was a law among the Spartans, that ſuch as fled from battle ſhould be degraded from their honours, ſhould be conſtrained to appear in garments patched with divers colours, to wear their beards half-ſhaved, and to ſuffer any to beat them who pleaſed, without reſiſtance. At preſent, however, this law was diſpenſed with; and Ageſilaus by his prudent conduct kept up the ſpirits of the people, at the ſame time that by his ſkill in military affairs he checked the progreſs of the enemy. Yet, during the lifetime of Epaminondas the Theban general, the war went on greatly to the diſadvantage of the Spartans; but he being killed at the battle of Mantinea, all parties became quickly deſirous of peace. Ageſilaus did not long ſurvive; and with him, we may ſay, periſhed the glory of Sparta. Soon after this all the ſtates of Greece fell under the power of Alexander the Great; and the Spartans, as well as the reſt, having become corrupt, and loſt their martial ſpirit, became a prey to domeſtic tyrants, and to foreign invaders. They maintained their ground, however, with great reſolution againſt the celebrated Pyrrhus king of Epirus; whom they repulſed for three days ſucceſſively, though not without aſſiſtance from one of the captains of Antigonus. Soon after this one of the kings of Sparta named *Agis*, perceiving the univerſal degeneracy that had taken place, made an attempt to reſtore the laws and diſcipline of Lycurgus, by which he ſuppoſed the ſtate would be reſtored to its former glory. But though at firſt he met with ſome appearance of ſucceſs, he was in a ſhort time tried and condemned by the ephori as a traitor to his country. Cleomenes, however, who aſcended the throne in 216 B. C. accompliſhed the reformation which Agis had attempted in vain. He ſuppreſſed the ephori; cancelled all debts; divided the lands equally, as they had been in the time of Lycurgus; and put an end to the luxury which prevailed among the citizens. But at laſt he was overborne by the number of enemies which ſurrounded him; and being defeated in battle by Antigonus, he fled to Egypt, where he put an end to his own life. With him periſhed every hope of retrieving the affairs of Sparta: the city for the preſent fell into the hands of Antigonus; after which a ſucceſſion of tyrants took place; till at laſt all diſturbances were ended by the Romans, who reduced MACEDON and GREECE to provinces of their empire, as has been related under theſe articles.

13
Agis and Cleomenes attempt in vain to reſtore it.

14
Inſtitutions of Lycurgus.

It remains now only to ſay ſomething concerning the character, manners, and cuſtoms of the Spartans, which, as they were founded on the laws of Lycurgus, may beſt be learned from a view of theſe laws.

The inſtitutions of Lycurgus were divided into 12 tables.

Sparta.

tables. The firſt comprehended ſuch of the Spartan laws as regarded religion. The ſtatues of all the gods and goddeſſes were repreſented in armour, even to Venus herſelf; the reaſon of which was, that the people might conceive a military life the moſt noble and honourable, and not attribute, as other nations did, ſloth and luxury to the gods. As to ſacrifices, they conſiſted of things of very ſmall value; for which Lycurgus himſelf gave this reaſon, That want might never hinder them from worſhipping the gods. They were forbidden to make long or raſh prayers to the heavenly powers, and were injoined to aſk no more than that they might live honeſtly and diſcharge their duty. Graves were permitted to be made within the bounds of the city, contrary to the cuſtom of moſt of the Greek nations; nay, they buried cloſe by their temples, that all degrees of people might be made familiar with death, and not conceive it ſuch a dreadful thing as it was generally eſteemed elſewhere: on the ſame account, the touching of dead bodies, or aſſiſting at funerals, made none unclean, but were held to be as innocent and honourable duties as any other. There was nothing thrown into the grave with the dead body; magnificent ſepulchres were forbidden; neither was there ſo much as an inſcription, however plain or modeſt, permitted. Tears, ſighs, outcries, were not allowed in public, becauſe they were thought diſhonourable in Spartans, whom their lawgiver would have to bear all things with equanimity. Mourning was limited to 11 days; on the 12th the mourner ſacrificed to Ceres, and threw aſide his weeds. In favour of ſuch as were ſlain in the wars, however, and of women who devoted themſelves to a religious life, there was an exception allowed as to the rules before-mentioned; for ſuch had a ſhort and decent inſcription on their tombs. When a number of Spartans fell in battle, at a diſtance from their country, many of them were buried together under one common tomb; but if they fell on the frontiers of their own ſtate, then their bodies were carefully carried back to Sparta, and interred in their family-ſepulchres.

15 His laws concerning religion.

16 Concerning the diviſion of land.

II. Lycurgus divided all the country of Laconia into 30,000 equal ſhares: the city of Sparta he divided into 9000, as ſome ſay; into 6000, as others ſay; and, as a third party will have it, into 4500. The intent of the legiſlator was, that property ſhould be equally divided amongſt his citizens, ſo that none might be powerful enough to oppreſs his fellows, or any be in ſuch neceſſity, as to be therefrom in danger of corruption. With the ſame view he forbade the buying or ſelling theſe poſſeſſions. If a ſtranger acquired a right to any of theſe ſhares, he might quietly enjoy it, provided he ſubmitted to the laws of the republic. The city of Sparta was unwalled; Lycurgus truſting it rather to the virtue of its citizens than to the art of maſons. As to the houſes, they were very plain; for their ceilings could only be wrought by the axe, and their gates and doors only by the ſaw; and their utenſils were to be of a like ſtamp, that luxury might have no inſtruments among them.

17 Of the citizen, children, &c.

III. The citizens were to be neither more nor leſs than the number of city lots; and if at any time there happened to be more, they were to be led out in colonies. As to children, their laws were equally harſh and unreaſonable; for a father was directed to carry his new-born infant to a certain place, where the graveſt men of his tribe looked upon the infant; and if they perceived its limbs ſtraight, and thought it had a wholeſome look, then they returned it to its parents to be educated; otherwiſe it was thrown into a deep cavern at the foot of the mountain Taygetus. This law ſeems to have had one very good effect, viz. making women very careful, when they were with child, of either eating, drinking, or exerciſing, to exceſs: it made them alſo excellent nurſes; for which they were in mighty requeſt throughout Greece. Strangers were not allowed to reſide long in the city, that they might not corrupt the Spartans by teaching them new cuſtoms. Citizens were alſo forbid to travel, for the ſame reaſon, unleſs the good of the ſtate required it. Such as were not bred up in their youth according to the law, were not allowed the liberty of the city, becauſe they held it unreaſonable, that one who had not ſubmitted to the laws in his youth ſhould receive the benefit of them when a man. They never preferred any ſtranger to a public office; but if at any time they had occaſion for a perſon not born a Spartan, they firſt made him a citizen, and then preferred him.

Sparta.

18 Of celibacy and marriage.

IV. Celibacy in men was infamous, and puniſhed in a moſt extraordinary manner; for the old bachelor was conſtrained to walk naked, in the depth of winter, through the market-place: while he did this, he was obliged to ſing a ſong in diſparagement of himſelf; and he had none of the honours paid him which otherwiſe belonged to old age, it being held unreaſonable, that the youth ſhould venerate him who was reſolved to leave none of his progeny behind him, to revere them when they grew old in their turn. The time of marriage was alſo fixed; and if a man did not marry when he was of full age, he was liable to an action; as were ſuch alſo as married above or below themſelves. Such as had three children had great immunities; ſuch as had four were free from all taxes whatſoever. Virgins were married without portions; becauſe neither want ſhould hinder a man, nor riches induce him, to marry contrary to his inclinations. When a marriage was agreed on, the huſband committed a kind of rape upon his bride. Huſbands went for a long time, ſecretly and by ſtealth, to the beds of their wives, that their love might not be quickly and eaſily extinguiſhed. Huſbands were allowed to lend their wives; but the kings were forbid to take this liberty. Some other laws of the like nature there were, which as they were evidently againſt modeſty, ſo they were far from producing the end for which Lycurgus deſigned them; ſince, though the men of Sparta were generally remarkable for their virtue, the Spartan women were as generally decried for their boldneſs and contempt of decency.

19 Education of their children.

V. It was the care of Lycurgus, that, from their very birth, the Lacedemonians ſhould be inured to conquer their appetites: for this reaſon he directed, that nurſes ſhould accuſtom their children to ſpare meals, and now-and then to faſting; that they ſhould carry them, when 12 or 13 years old, to thoſe who ſhould examine their education, and who ſhould carefully obſerve whether they were able to be in the dark alone, and whether they had got over all other follies and weakneſſes incident to children. He directed, that children of all ranks ſhould be brought up in the ſame way; and that none ſhould be more favoured in food than another, that they might not, even in their infancy,

Sparta. infancy, perceive any difference between poverty and riches, but conſider each other as equals, and even as brethren, to whom the ſame portions were aſſigned, and who, through the courſe of their lives, were to fare alike: the youths alone were allowed to eat fleſh; older men ate their black broth and pulſe; the lads ſlept together in chambers, and after a manner ſomewhat reſembling that ſtill in uſe in Turkey for the Janizaries: their beds, in the ſummer, were very hard, being compoſed of the reeds plucked by the hand from the banks of the Eurotas: in winter their beds were ſofter, but by no means downy, or fit to indulge immoderate ſleep. They ate altogether in public; and in caſe any abſtained from coming to the tables, they were fined. It was likewiſe ſtrictly forbidden for any to eat or drink at home before they came to the common meal; even then each had his proper portion, that every thing might be done there with gravity and decency. The black broth was the great rarity of the Spartans, which was compoſed of ſalt, vinegar, blood, &c. ſo that, in our times, it would be eſteemed a very unſavoury ſoup. If they were moderate in their eating, they were ſo in their drinking alſo; thirſt was the ſole meaſure thereof; and never any Lacedemonian thought of drinking for pleaſure: as for drunkenneſs, it was both infamous and ſeverely puniſhed; and, that young men might perceive the reaſon, ſlaves were compelled to drink to exceſs, that the beaſtlineſs of the vice might appear. When they retired from the public meal, they were not allowed any torches or lights, becauſe it was expected, that men who were perfectly ſober ſhould be able to find their way in the dark: and, beſides, it gave them a facility of marching without light; a thing wonderfully uſeful to them in time of war.

20 Of their diet, clothing, &c.

VI. As the poor ate as well as the rich, ſo the rich could wear nothing better than the poor: they neither changed their faſhion nor the materials of their garments; they were made for warmth and ſtrength, not for gallantry and ſhow: and to this cuſtom even their kings conformed, who wore nothing gaudy in right of their dignity, but were contented that their virtue ſhould diſtinguiſh them rather than their clothes. The youths wore a tunic till they were twelve years old; afterwards they had a cloak given them, which was to ſerve them a year: and their clothing was, in general, ſo thin, that a Lacedemonian veſt became proverbial. Boys were always uſed to go without ſhoes; but when they grew up, they were indulged with them, if the manner of life they led required it; but they were always inured to run without them, as alſo to climb up and ſlip down ſteep places with bare feet: nay, the very ſhoe they uſed was of a particular form, plain and ſtrong. Boys were not permitted to wear their hair; but when they arrived at the age of twenty, they ſuffered their hair and beard to grow. Baths and anointing were not much in uſe among the Lacedemonians; the river Eurotas ſupplied the former, and exerciſe the latter. In the field, however, their ſumptuary laws did not take place ſo ſtrictly as in the city; for when they went to war, they wore purple habits; they put on crowns when they were about to engage the enemy; they had alſo rings, but they were of iron; which metal was moſt eſteemed by this nation. Young women wore their veſts or jerkins only to their knees, or, as ſome think, not quite ſo low; a cuſtom which both Greek and Roman authors cenſure as indecent. Gold, precious ſtones, and other coſtly ornaments, were permitted only to common women; which permiſſion was the ſtrongeſt prohibition to women of virtue, or who affected to be thought virtuous. Virgins went abroad without veils, with which married women, on the contrary, were always covered. In certain public exerciſes, in which girls were admitted as well as boys, they were both obliged to perform naked. Plutarch apologiſes for this cuſtom, urging, that there could be no danger from nakedneſs to the morals of youth whoſe minds were fortified and habituated to virtue. One of Lycurgus's principal views in his inſtitutions, was to eradicate the very ſeeds of civil diſſenſion in his republic. Hence proceeded the equal diviſion of eſtates injoined by him; hence the contempt of wealth, and the neglect of other diſtinctions, as particularly birth, he conſidering the people of his whole ſtate as one great family; diſtinctions which, in other commonwealths, frequently produce tumults and confuſions that ſhake their very foundation. Sparta.

21 Obedience to their ſuperiors.

VII. Though the Spartans were always free, yet it was with this reſtriction, that they were ſubſervient to their own laws, which bound them as ſtrictly in the city as ſoldiers, in other ſtates, were bound by the rules of war in the camp. In the firſt place, ſtrict obedience to their ſuperiors was the great thing required in Sparta. This they looked upon as the very baſis of government; without which neither laws nor magiſtrates availed much. Old age was an indubitable title to honour in Sparta: to the old men the youth roſe up whenever they came into any public place; they gave way to them when they met them in the ſtreets, and were ſilent whenever their elders ſpoke. As all children were looked upon as the children of the ſtate, ſo all the old men had the authority of parents: they reprehended whatever they ſaw amiſs, not only in their own, but in other people's children; and by this method Lycurgus provided, that as youth are everywhere apt to offend, they might be nowhere without a monitor. The laws went ſtill further: if an old man was preſent where a young one committed a fault, and did not reprove him, he was puniſhed equally with the delinquent. Amongſt the youths there was one of their own body, or at moſt two years older than the reſt, who was ſtyled *iren*: he had authority to queſtion all their actions, to look ſtrictly to their behaviour, and to puniſh them if they did amiſs; neither were their puniſhments light, but, on the contrary, very ſevere; whereby the youth were made hardy, and accuſtomed to bear ſtripes and rough uſage. Silence was a thing highly commended at Sparta, where modeſty was held to be a moſt becoming virtue in young people; nor was it reſtrained only to their words and actions, but to their very looks and geſtures; Lycurgus having particularly directed, that they ſhould look forward, or on the ground, and that they ſhould always keep their hands within their robes. A ſtupid inconſiderate perſon, one who would not liſten to inſtruction, but was careleſs of whatever the world might ſay of him, the Lacedemonians treated as a ſcandal to human nature; with ſuch an one they would not converſe, but threw him off as a rotten branch and worthleſs member of ſociety.

22 Learning

VIII. The plainneſs of their manners, and their being ſo very much addicted to war, made the Lacedemonians

Sparta. monians leſs fond of the ſciences than the reſt of the Greeks. A ſoldier was the only reputable profeſſion in Sparta; a mechanic or huſbandman was thought a low fellow. The reaſon of this was, that they imagined profeſſions which required much labour, ſome conſtant poſture, being continually in the houſe, or always about a fire, weakened the body and depreſſed the mind: whereas a man brought up hardily, was equally fit to attend the ſervice of the republic in time of peace, and to fight its battles when engaged in war. Such occupations as were neceſſary to be followed for the benefit of the whole, as huſbandry, agriculture, and the like, were left to their ſlaves the Helotes; but for curious arts, and ſuch as ſerved only to luxury, they would not ſo much as ſuffer them to be introduced in their city; in conſequence of which, rhetoricians, augurs, bankers, and dealers in money, were ſhut out. The Spartans admitted not any of the theatrical diverſions among them; they would not bear the repreſentation of evil even to produce good; but other kinds of poetry were admitted, provided the magiſtrates had the peruſal of pieces before they were handed to the public.

Above all things, they affected brevity of ſpeech, and accuſtomed their children, from their very infancy, never to expreſs themſelves in more words than were ſtrictly neceſſary; whence a conciſe and ſententious oratory is to this day ſtyled *Laconic*. In writing they uſed the ſame conciſeneſs; of which we have a ſignal inſtance in a letter of Archidamus to the Eleans, when he underſtood that they had ſome thoughts of aſſiſting the Arcadians. It ran thus: "Archidamus to the Eleans: It is good to be quiet." And therefore Epaminondas thought that he had reaſon to glory in having forced the Spartans to abandon their monoſyllables, and to lengthen their diſcourſes.

The greateſt part of their education conſiſted in giving their youth right ideas of men and things: the men or maſter propoſed queſtions, and either commended the anſwers that were made him, or reproved ſuch as anſwered weakly. In theſe queſtions, all matters, either of a trivial or abſtruſe nature, were equally avoided; and they were confined to ſuch points as were of the higheſt importance in civil life; ſuch as, Who was the beſt man in the city? Wherein lay the merit of ſuch an action? and, Whether this or that hero's fame was well-founded? Harmleſs raillery was greatly encouraged; and this, joined to their ſhort manner of ſpeaking, rendered laconic replies univerſally admired.

Muſic was much encouraged; but in this, as in other things, they adhered to that which had been in favour with their anceſtors; nay, they were ſo ſtrict therein, that they would not permit their ſlaves to learn either the tune or the words of their moſt admired odes; or, which is all one, they would not permit them to ſing them if they had learned them. Though the youth of the male ſex were much cheriſhed and beloved, as thoſe that were to build up and continue the future glory of the ſtate, yet in Sparta it was a virtuous and modeſt affection, untinged with that ſenſuality which was ſo ſcandalous at Athens. The good effects of this part of Lycurgus's inſtitutions were ſeen in the union that reigned among his citizens; and which was ſo extraordinary, that even in caſes of competition, it was hardly known that rivals bore ill-will to each other; but, on the contrary, their love to the ſame perſon begat a ſecondary friendſhip among themſelves, and united them in all things which might be for the benefit of the perſon beloved. Sparta.

Some authors have accuſed this great lawgiver of encouraging theft in his inſtitutions; which, they ſay, was not held ſcandalous among the Spartans, if it were ſo dexterouſly managed as that the perſon was not detected in it. But this is certain, and ſeems to be a ſtrong contradiction of the heinous charge, that when a theft was diſcovered, it was puniſhed with the utmoſt ſeverity: a perſon even ſuſpected of it would endure the heavieſt puniſhments rather than acknowledge it, and be branded with ſo baſe a crime.

23 Exerciſes.

IX. The exerciſes inſtituted by law fall under the ninth table. In theſe all the Greeks were extremely careful, but the Lacedemonians in a degree beyond the reſt; for if a youth, by his corpulence, or any other means, became unfit for theſe exerciſes, he underwent public contempt at leaſt, if not baniſhment.—Hunting was the uſual diverſion of their children; nay, it was made a part of their education, becauſe it had a tendency to ſtrengthen their limbs, and to render thoſe who practiſed it ſupple and fleet: they likewiſe bred up dogs for hunting with great care. They had a kind of public dances, in which they exceedingly delighted, and which were common alike to virgins and young men: indeed, in all their ſports, girls were allowed to divert themſelves with the youths; inſomuch that, at darting, throwing the quoit, pitching the bar, and ſuch-like robuſt diverſions, the women were as dexterous as the men. For the manifeſt oddity of this proceeding, Lycurgus aſſigned no other reaſon, than that he ſought to render women, as well as men, ſtrong and healthy, that the children they brought forth might be ſo too. Violent exerciſes, and a laborious kind of life, were only enjoined the youth; for when they were grown up to mens eſtate, that is, were upwards of 30 years old, they were exempted from all kinds of labour, and employed themſelves wholly either in affairs of ſtate or in war. They had a method of whipping, at a certain time, young men in the temple of Diana, and about her altar; which, however palliated, was certainly unnatural and cruel. It was eſteemed a great honour to ſuſtain theſe flagellations without weeping, groaning, or ſhowing any ſenſe of pain; and the thirſt of glory was ſo ſtrong in theſe young minds, that they very frequently ſuffered death without ſhedding a tear or breathing a ſigh. A deſire of overcoming all the weakneſſes of human nature, and thereby rendering his Spartans not only ſuperior to their neighbours, but to their ſpecies, runs through many of the inſtitutions of Lycurgus; which principle, if well attended to, thoroughly explains them, and without attending to which it is impoſſible to give any account of them at all.

24 Money, &c.

X. Gold and ſilver were, by the conſtitutions of Lycurgus, made of no value in Sparta. He was ſo well apprized of the danger of riches, that he made the very poſſeſſion of them venal; but as there was no living without ſome ſort of money, that is, ſome common meaſure or ſtandard of the worth of things, he directed an iron coinage, whereby the Spartans were ſupplied with the uſeful money, and at the ſame time had no temptation to covetouſneſs afforded them; for a very ſmall ſum was ſufficient to load a couple of horſes, and

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Sparta. a great one muſt have been kept in a barn or warehouſe. The coming in of all foreign money was alſo prohibited, that corruption might not enter under the name of commerce. The moſt ancient method of dealing, viz. by barter, or exchange of one commodity for another, was preſerved by law in Sparta long after it had been out of date everywhere elſe. Intereſt was a thing forbidden in the Spartan commonwealth; where they had alſo a law againſt alienation of lands, accepting preſents from foreigners, even without the limits of their own country, and when their authority and character might well ſeem to excuſe them.

25 Courts of juſtice. XI. Such of the laws of Sparta as related to courts of juſtice may be brought under the 11th table. Thirty years muſt have paſſed over the head of him who had a right to concern himſelf in juridical proceedings. Young men were thought unfit for them; and it was even held indecent, and of ill report, for a man to have any fondneſs for law-ſuits, or to be buſying himſelf at the tribunals, when he had no affairs there of his own. By theſe rules Lycurgus thought to ſhut out litigiouſneſs, and to prevent that multiplicity of ſuits which is always ſcandalous in a ſtate. As young people were not permitted to inquire about the laws of other countries, and as they were hindered from hearing judicial proceedings in their courts, ſo they were likewiſe forbidden to aſk any queſtions about, or to endeavour to diſcover, the reaſons of the laws by which themſelves were governed. Obedience was their duty; and to that alone they would have them kept. Men of abandoned characters, or who were notoriouſly of ill fame, loſt all right of giving their votes in reſpect of public affairs, or of ſpeaking in public aſſemblies; for they would not believe that an ill man in private life could mean his country better than he did his neighbour.

26 Military ſervice. XII. Till a man was 30 years old, he was not capable of ſerving in the army, as the beſt authors agree; though ſome think that the military age is not well aſcertained by ancient writers. They were forbidden to march at any time before the full-moon; the reaſon of which law is very hard to be diſcovered, if indeed it had any reaſon at all, or was not rather founded on ſome ſuperſtitious opinion, that this was a more lucky conjuncture than any other. They were likewiſe forbidden to fight often againſt the ſame enemy; which was one of the wiſeſt maxims in the political ſyſtem of Lycurgus: and Ageſilaus, by offending againſt it, deſtroyed the power of his country, and loſt her that authority which for many ages ſhe maintained over the reſt of Greece; for, by continually warring againſt the Thebans, to whom he had an inveterate hatred, he at laſt beat them into the knowledge of the art of war, and enabled them, under the command of Epaminondas, to maintain for a time the principality of Greece. Maritime affairs they were forbidden to meddle with, though the neceſſity of things compelled them, in proceſs of time, to tranſgreſs this inſtitution, and by degrees to transfer to themſelves the dominion of the ſea as well as of the land: but, after the Peloponneſian war, they again neglected naval affairs, from a perſuaſion that ſailors and ſtrangers corrupted thoſe with whom they converſed. As they never fortified Sparta, they were not ready to undertake ſieges: fighting in the field was their proper province, and, while they could overcome their enemies there, they rightly conceived that nothing could hurt them at home. In time of war, they relaxed ſomewhat of their ſtrict manner of living, in which they were ſingular. The true reaſon for this was, in all probability, that war might be leſs burdenſome to them; for, as we have more than once obſerved, a ſtrong deſire to render them bold and warlike was the reigning paſſion of their legiſlator. They were forbidden to remain long encamped in the ſame place, as well to hinder their being ſurpriſed, as that they might be more troubleſome to their enemies, by waſting every corner of their country. They ſlept all night in their armour; but their outguards were not allowed their ſhields, that, being unprovided of defence, they might not dare to ſleep. In all expeditions they were careful in the performance of religious rites; and, after their evening-meal was over, the ſoldiers ſung together hymns to their gods. When they were about to engage, the king ſacrificed to the muſes, that, by their aſſiſtance, they might be enabled to perform deeds worthy of being recorded to lateſt times. Then the army advanced in order to the ſound of flutes, which played the hymn of Caſtor. The king himſelf ſung the pæan, which was the ſignal to charge. This was done with all the ſolemnity imaginable; and the ſoldiers were ſure either to die or conquer: indeed they had no other choice; for if they fled they were infamous, and in danger of being ſlain, even by their own mothers, for diſgracing their families. In this conſiſted all the excellency of the Spartan women, who, if poſſible, exceeded in bravery the men, never lamenting over huſbands or ſons, if they died honourably in the field; but deploring the ſhame brought on their houſe, if either the one or the other eſcaped by flight. The throwing away a ſhield alſo induced infamy; and, with reſpect to this, mothers, when they embraced their departing ſons, were wont to caution them, that they ſhould either return armed as they were, or be brought back ſo when they were dead; for, as we have obſerved, ſuch as were ſlain in battle were nevertheleſs buried in their own country. When they made their enemies fly, they purſued no longer than till victory was certain; becauſe they would ſeem to fight rather for the honour of conquering, than of putting their enemies to death. According to their excellent rules of war, they were bound not to ſpoil the dead bodies of their enemies; but in proceſs of time, this, and indeed many other of their moſt excellent regulations, fell into deſuetude. He who overcame by ſtratagem, offered up an ox to Mars; whereas he who conquered by force, offered up only a cock; the former being eſteemed more manly than the latter. After 40 years ſervice, a man was, by law, no longer required to go into the field; and conſequently, if the military age was 30, the Spartans were not held invalids till they were 70.

Sparta || Spartium.

SPARTIANUS (Ælius), a Latin hiſtorian, who wrote the lives of Adrian, Caracalla, and four other Roman emperors. He lived under the reign of Dioclefian, about the year 290.

SPARTIUM, Broom, in botany: A genus of plants belonging to the claſs of *diadelphia*, and order of *decandria*; and in the natural ſyſtem arranged under the 32d order, *Papilionaceæ*. The ſtigma is longitudinal and woolly above: the filaments adhere to the germen. The calyx is produced downwards. There are 16 ſpecies,

Spartium. the ſcoparium, contaminatum, ſepiarium, junceum, monoſpermum, ſphœrocarpon, purgans, aphyllum, ſcorpius, angulatum, patens, ſupranulium, complicatum, radiatum, cytiſoides, and ſpinoſum. All theſe, except the ſcoparium, are exotics, chiefly from Spain, Portugal, Italy, &c.—The *ſcoparium*, or common broom, has ternate ſolitary leaves; the branches angular, and without prickles.

Uſes. The common broom is uſed for a variety of purpoſes. It has been of great benefit ſometimes in dropſical complaints. The manner in which Dr Cullen adminiſtered it was this: He ordered half an ounce of freſh broom tops to be boiled in a pound of water till one half of the water was evaporated. He then gave two table-ſpoonfuls of the decoction every hour till it operated both by ſtool and urine. By repeating theſe doſes every day, or every ſecond day, he ſays ſome dropſies have been cured. Dr Mead relates, that a dropſical patient, who had taken the uſual remedies, and been tapped three times without effect, was cured by taking half a pint of the decoction of green broom tops, with a ſpoonful of whole muſtard-ſeed every morning and evening. "An infuſion of the ſeeds drunk freely (ſays Mr Withering) has been known to produce ſimilar happy effects; but whoever expects theſe effects to follow in every dropſical caſe, will be greatly deceived. I knew them ſucceed in one caſe that was truly deplorable; but out of a great number of caſes in which the medicine had a fair trial, this proved a ſingle inſtance."

The flower buds are in ſome countries pickled, and eaten as capers; and the ſeeds have been uſed as a bad ſubſtitute for coffee. The branches are uſed for making beſoms, and tanning leather. They are alſo uſed inſtead of thatch to cover houſes. The old wood furniſhes the cabinet-maker with beautiful materials for veneering. The tender branches are in ſome places mixed with hops for brewing, and the macerated bark may be manufactured into cloth.

The *junceum*, or Spaniſh broom, grows naturally in the ſouthern provinces of France, as well as other parts of the ſouth of Europe. It grows in the pooreſt ſoils, on the ſteepeſt declivities of the hills, in a ſtony ſoil, where hardly any other plant could vegetate. In a few years it makes a vigorous ſhrub; inſinuating its roots between the interſtices of the ſtones, it binds the ſoil, and retains the ſmall portion of vegetable earth ſcattered over theſe hills, which the autumnal rains would otherwiſe waſh away. It is moſt eaſily raiſed from ſeed, which is uſually ſown in January, after the ground has received a ſlight dreſſing.

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This ſhrub ſerves two uſeful purpoſes. Its branches yield a thread of which linen is made, and in winter ſupport ſheep and goats.

In manufacturing thread from broom, the youngeſt plants are cut in the month of Auguſt, or after harveſt, and gathered together in bundles, which at firſt are laid in the ſun to dry: they are then beaten with a piece of wood, waſhed in a river or pond, and left to ſteep in the water for about four hours. The bundles thus prepared are taken to a little diſtance from the water, and laid in a hollow place made for them, where they are covered with fern or ſtraw, and remain thus to ſteep for eight or nine days; during which time, all that is neceſſary, is to throw a little water once a-day on the heap, without uncovering the broom. After this, the bundles are well waſhed, the green rind of the plant or epidermis comes off, and the fibrous part remains; each bundle is then beaten with a wooden hammer upon a ſtone, to detach all the threads, which are at the ſame time carefully drawn to the extremity of the branches. After this operation, the faggots are untied, and ſpread upon ſtones or rocks till they are dry. The twigs muſt not be peeled till they are perfectly dry; they are then dreſſed with the comb, and the threads are ſeparated according to their fineneſs, and ſpun upon a wheel. Spartium, Sparus.

The linen made of this thread ſerves various purpoſes in rural economy. The coarſeſt is employed in making ſacks and other ſtrong cloths for carrying grain or ſeeds. Of the fineſt is made bed, table, and body linen. The peaſants in ſeveral places uſe no other, for they are unacquainted with the culture of hemp or flax, their ſoil being too dry and too barren for raiſing them. The cloth made with the thread of the broom is very uſeful; it is as ſoft as that made of hemp; and it would perhaps look as well as that made of flax if it was more carefully ſpun. It becomes white in proportion as it is ſteeped. The price of the fineſt thread, when it is ſold, which ſeldom happens, is generally about a ſhilling a-pound.

The other uſe to which this broom is applied, is to maintain ſheep and goats during winter. In the mountains of Lower Languedoc theſe animals have no other food from November to April, except the leaves of trees preſerved. The branches of this broom therefore are a reſource the more precious, that it is the only freſh nouriſhment which at that ſeaſon the flocks can procure, and they prefer it at all times to every other plant. In fine weather the ſheep are led out to feed on the broom where it grows; but in bad weather the ſhepherds cut the branches, and bring them to the ſheep-folds. There is, however, an inconvenience attending the continued uſe of this food. It generally produces inflammation in the urinary paſſages. But this inconvenience is eaſily removed by cooling drink, or a change of food, or by mixing the broom with ſomething elſe.

It is perhaps needleſs to add, that it differs much from the broom that is common everywhere in the north of Europe, though this too, in many places, is uſed for food to cattle. Both of them produce flowers that are very much reſorted to by bees, as they contain a great quantity of honey juice. And this ſhould be another inducement to the cultivation of the Spaniſh broom.

SPARUS, Gilthead, in natural hiſtory; a genus of animals belonging to the claſs of *piſces*, and the order of *thoracici*. The fore-teeth and dog-teeth are very ſtrong; the grinders are obtuſe and thick ſet; the lips are folded over; there are five rays in the gill membrane; and the opercula are ſcaly: the body is compreſſed; the lateral line is crooked behind; and the pectoral fins are roundiſh.

Gmelin enumerates 39 ſpecies, of which only three are found in the Britiſh ſeas, the pagrus, auratus, and dentatus. 1. The *pagrus*, or ſea-bream, is of a reddiſh colour. The ſkin forms a ſinus at the roots of the dorſal and anal fins. The body is broad; the back and belly ridged. There is only one dorſal fin. 2. The *auratus*, or gilt-bream. The head and ſides of it are gilt, and there is a golden ſpot between the eyes ſhaped like a half-moon; there is alſo a black purple ſpot on the gills; and it weighs from eight lb. to ten lb. It is one

Spaſm ‖ Speaker.

of the *piſces ſaxatiles*, or fiſh that haunts deep waters on bold rocky ſhores. They feed chiefly on ſhell-fiſh, which they comminute with their teeth before they ſwallow; the teeth of this genus in particular being adapted for that purpoſe: the grinders are flat and ſtrong, like thoſe of certain quadrupeds: beſides which there are certain bones in the lower part of the mouth that aſſiſt in grinding their food. They are but a coarſe fiſh: they were known to the Romans, who did not eſteem them unleſs they were fed with Lucrine oyſters, as Martial informs us,

Non omnis laudem pretiumque AURATA *meretur,*
Sed qui ſolus erit concha Lucrina cibus.
Lib. xiii. Ep. 90.

3. The *dentatus*, toothed ſea-bream, is black above, and of a ſilvery appearance below. The eyes and gills are very large. There are nine rows of teeth in the lower jaw, and one in the upper.

In the account of Captain Cook's voyage publiſhed by Mr Forſter, we are informed, that the giltheads are ſometimes poiſonous, owing to their feeding on certain ſpecies of the raja, which have an extremely acrid and ſtimulating property.

SPASM, a convulſion. See MEDICINE, n° 278.

SPATHA, in botany, a ſheath; a ſpecies of calyx which burſts lengthwiſe, and protrudes a ſtalk ſupporting one or more flowers, which commonly have no perianthium or flower-cup.

SPATHACEÆ (from *ſpatha*, "a ſheath"), the name of the ninth order in Linnæus's Fragments of a Natural Method, conſiſting of plants whoſe flowers are protruded from a ſpatha or ſheath. See BOTANY, p. 458.

SPATHELIA, in botany; a genus of plants belonging to the claſs of *pentandria*, and to the order of *trigynia*. The calyx is pentaphyllous; the petals are five; the capſule is three-edged and trilocular; the ſeeds ſolitary. There is only one ſpecies, the *ſimplex*, which is a native of Jamaica, and was introduced into the botanic gardens of this country in 1778 by Dr Wright, late of Jamaica.

SPAW. See SPA.

SPAWN, in natural hiſtory, the eggs of fiſhes or frogs. See FISH and RANA.

SPAVENTO. See SCANTO.

SPAVIN, in the manege, a diſeaſe in horſes, being a ſwelling or ſtiffneſs, uſually in the ham, occaſioning a lameneſs. See FARRIERY, § 29.

SPAYING, or SPADING, the operation of caſtrating the females of ſeveral kinds of animals, as ſows, bitches, &c. to prevent any further conception, and promote their fattening. It is performed by cutting them in the mid flank, on the left ſide, with a ſharp knife or lancet, taking out the uterus, and cutting it off, and ſo ſtitching up the wound, anointing the part with tar, and keeping the animal warm for two or three days. The uſual way is to make the inciſion aſlope, two inches and a half long; that the fore-finger may be put in towards the back, to feel for the ovaries, which are two kernels as big as acorns on both ſides of the uterus, one of which is drawn to the wound, and thus both taken out.

SPEAKER *of the Houſe of Commons*, a member of the houſe elected by a majority of votes thereof to act as chairman or preſident in putting queſtions, reading briefs, or bills, keeping order, reprimanding the refractory, adjourning the houſe, &c. See PARLIAMENT.

Speaking ‖ Specific Gravity.

SPEAKING, the art or act of expreſſing one's thoughts in articulate ſounds or words. See GRAMMAR, LANGUAGE, READING, and ORATORY, Part iv.

SPEAKING-Trumpet. See TRUMPET.

SPEAR-MINT, in botany. See MENTHA.

SPEAR-Wort. See RANUNCULUS.

SPECIAL, ſomething that is particular, or has a particular deſignation; from the Latin *ſpecies*, in oppoſition to the *general*, from *genus*.

SPECIES, in logic, a relative term, expreſſing an idea which is compriſed under ſome general one called a *genus*. See LOGIC, n° 68.

SPECIES, in commerce, the ſeveral pieces of gold, ſilver, copper, &c. which having paſſed their full preparation and coinage, are current in public. See MONEY.

SPECIFIC, in philoſophy, that which is peculiar to any thing, and diſtinguiſhes it from all others.

SPECIFICS, in medicine. By ſpecifics is not meant ſuch as infallibly and in all patients produce ſalutary effects. Such medicines are not to be expected, becauſe the operations and effects of remedies are not formally inherent in them, but depend upon the mutual action and reaction of the body and medicine upon each other; hence the various effects of the ſame medicine in the ſame kind of diſorders in different patients, and in the ſame patient at different times. By ſpecific medicines we underſtand ſuch medicines as are more infallible than any other in any particular diſorder.

SPECIFIC Gravity, is a term much employed in the diſcuſſions of modern phyſics. It expreſſes the weight of any particular kind of matter, as compared with the weight of the ſame bulk of ſome other body of which the weight is ſuppoſed to be familiarly known, and is therefore taken for the ſtandard of compariſon. The body generally made uſe of for this purpoſe is pure water. See HYDROSTATICS, Sect. III.

The ſpecific gravity of bodies is a very intereſting queſtion both to the philoſopher and to the man of buſineſs. The philoſopher conſiders the weights of bodies as meaſures of the number of material atoms, or the quantity of matter which they contain. This he does on the ſuppoſition that every atom of matter is of the ſame weight, whatever may be its ſenſible form. This ſuppoſition, however, is made by him with caution, and he has recourſe to ſpecific gravity for aſcertaining its truth in various ways. This ſhall be conſidered by and by. The man of buſineſs entertains no doubt of the matter, and proceeds on it as a ſure guide in his moſt intereſting tranſactions. We meaſure commodities of various kinds by tons, pounds, and ounces, in the ſame manner as we meaſure them by yards, feet, and inches, or by buſhels, gallons, and pints; nay, we do this with much greater confidence, and prefer this meaſurement to all others, whenever we are much intereſted to know the exact proportions of matter that bodies contain. The weight of a quantity of grain is allowed to inform us much more exactly of its real quantity of uſeful matter than the moſt accurate meaſure of its bulk. We ſee many circumſtances which can vary the bulk of a quantity of matter, and theſe are frequently ſuch as we cannot

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not regulate or prevent; but we know very few indeed that can make any ſenſible change in this weight without the addition or abſtraction of other matter. Even taking it to the ſummit of a high mountain, or from the equator to the polar region, will make no change in its weight as it is aſcertained by the balance, becauſe there is the ſame real diminution of weight in the pounds and ounces uſed in the examination.

Notwithſtanding the unavoidable change which heat and cold make in the bulk of bodies, and the permanent varieties of the ſame kind of matter which are cauſed by different circumſtances of growth, texture, &c. moſt kinds of matter have a certain conſtancy in the denſity of their particles, and therefore in the weight of a given bulk. Thus the purity of gold, and its degree of adulteration, may be inferred from its weight, it being purer in proportion as it is more denſe. The denſity, therefore, of different kinds of tangible matter becomes characteriſtic of the kind, and a teſt of its purity; it marks a particular appearance in which matter exiſts, and may therefore be called, with propriety, SPECIFIC.

But this denſity cannot be directly obſerved. It is not by comparing the diſtances between the atoms of matter in gold and in water that we ſay the firſt is 19 times denſer than the laſt, and that an inch of gold contains 19 times as many material atoms as an inch of water; we reckon on the equal gravitation of every atom of matter whether of gold or of water; therefore the weight of any body becomes the indication of its material denſity, and the weight of a given bulk becomes ſpecific of that kind of matter, marking its kind, and even aſcertaining its purity in this form.

It is evident that, in order to make this compariſon of general uſe, the ſtandard muſt be *familiarly known*, and muſt be very uniform in its denſity, and the compariſon of bulk and denſity muſt be eaſy and accurate. The moſt obvious method would be to form, with all nicety, a piece of the ſtandard matter of ſome convenient bulk, and to weigh it very exactly, and keep a note of its weight: then, to make the compariſon of any other ſubſtance, it muſt be made into a maſs of the ſame preciſe bulk, and weighed with equal care; and the moſt convenient way of expreſſing the ſpecific gravity would be to conſider the weight of the ſtandard as unity, and then the number expreſſing the ſpecific gravity is the number of times that the weight of the ſtandard is contained in that of the other ſubſtance. This compariſon is moſt eaſily and accurately made in fluids. We have only to make a veſſel of known dimenſions equal to that of the ſtandard which we employ, and to weigh it when empty, and then when filled with the fluid. Nay, the moſt difficult part of the proceſs, the making a veſſel of the preciſe dimenſions of the ſtandard, may be avoided, by *uſing* ſome fluid ſubſtance for a ſtandard. Any veſſel will then do; and we may enſure very great accuracy by uſing a veſſel with a ſlender neck, ſuch as a phial or matraſs; for when this is filled to a certain mark in the neck, any error in the eſtimation by the eye will bear a very ſmall proportion to the whole. The weight of the ſtandard fluid which fills it to this mark being carefully aſcertained, is kept in remembrance. The ſpecific gravity of any other fluid is had by weighing the contents of this veſſel when filled with it, and dividing the weight by the weight of the ſtandard. The quotient is the ſpecific gravity of the fluid. But in all other caſes this is a very difficult problem: it requires very nice hands, and an accurate eye, to make two bodies of the ſame bulk. An error of one hundredth part in the linear dimenſions of a ſolid body makes an error of a 30th part in its bulk; and bodies of irregular ſhapes and friable ſubſtance, ſuch as the ores of metals, cannot be brought into convenient and exact dimenſions for meaſurement.

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From all theſe inconveniences and difficulties we are freed by the celebrated Archimedes, who, from the principles of hydroſtatics diſcovered or eſtabliſhed by him, deduced the accurate and eaſy method which is now univerſally practiſed for diſcovering the ſpecific gravity and denſity of bodies. (See ARCHIMEDES and HYDROSTATICS, n° 11.) Inſtead of meaſuring the bulk of the body by that of the diſplaced fluid (which would have been impoſſible for Archimedes to do with any thing like the neceſſary preciſion), we have only to obſerve the loſs of weight ſuſtained by the ſolid. This can be done with great eaſe and exactneſs. Whatever may be the bulk of the body, this loſs of weight is the weight of an equal bulk of the fluid; and we obtain the ſpecific gravity of the body by ſimply dividing its whole weight by the weight loſt: the quotient is the ſpecific gravity when this fluid is taken for the ſtandard, even though we ſhould not know the abſolute weight of any given bulk of this ſtandard. It alſo gives us an eaſy and accurate method of aſcertaining even this fundamental point. We have only to form any ſolid body into an exact cube, ſphere, or priſm, of known dimenſions, and obſerve what weight it loſes when immerſed in this ſtandard fluid. This is the weight of the ſame bulk of the ſtandard to be kept in remembrance; and thus we obtain, by the by, a moſt eaſy and accurate method for meaſuring the bulk or ſolid contents of any body, however irregular its ſhape may be. We have only to ſee how much weight it loſes in the ſtandard fluid; we can compute what quantity of the ſtandard fluid will have this weight. Thus ſhould we find that a quantity of ſand, or a furze buſh, loſes 250 ounces when immerſed in pure water, we learn by this that the ſolid meaſure of every grain of the ſand, or of every twig and prickle of the furze, when added into one ſum, amounts to the fourth part of a cubic foot, or to 432 cubic inches.

To all theſe advantages of the Archimedean method of aſcertaining the ſpecific gravity of bodies, derived from his hydroſtatical doctrines and diſcoveries, we may add, that the immediate ſtandard of compariſon, namely, water, is, of all the ſubſtances that we know, the fitteſt for the purpoſe of an univerſal ſtandard of reference. In its ordinary natural ſtate it is ſufficiently conſtant and uniform in its weight for every examination where the utmoſt mathematical accuracy is not wanted; all its variations ariſe from impurities, from which it may at all times be ſeparated by the ſimple proceſs of diſtillation: and we have every reaſon to think that when pure, its denſity, when of the ſame temperature, is invariable.

Water is therefore univerſally taken for the unit of that ſcale on which we meaſure the ſpecific gravity of bodies, and its weight is called 1. The ſpecific gravity of any other body is the real weight in pounds and ounces, when of the bulk of one pound or one ounce of water. It is therefore of the firſt importance, in all

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diſcuſſions reſpecting the ſpecific gravity of bodies, to have the preciſe weight of ſome known bulk of pure water. We have taken ſome pains to examine and compare the experiments on this ſubject, and ſhall endeavour to aſcertain this point with the preciſion which it deſerves. We ſhall reduce all to the Engliſh cubic foot and avoirdupois ounce of the Exchequer ſtandard, on account of a very convenient circumſtance peculiar to this unit, viz. that a cubic foot contains almoſt preciſely a thouſand ounces of pure water, ſo that the ſpecific gravity of bodies expreſſes the number of ſuch ounces contained in a cubic foot.

We begin with a trial made before the houſe of commons in 1696 by Mr Everard. He weighed 2145,6 cubic inches of water by a balance, which turned ſenſibly with 6 grains, when there were 30 pounds in each ſcale. The weights employed were the troy weights, in the depoſit of the Court of Exchequer, which are ſtill preſerved, and have been moſt ſcrupulouſly examined and compared with each other. The weight was 1131 ounces 14 pennyweights. This wants juſt 11 grains of a thouſand avoirdupois ounces for 1728 cubic inches, or a cubic foot; and it would have amounted to that weight had it been a degree or two colder. The temperature indeed is not mentioned; but as the trial was made in a comfortable room, we may preſume the temperature to have been about 55° of Fahrenheit's thermometer. The dimenſions of the veſſel were as accurate as the nice hand of Mr Abraham Sharp, Mr Flamſtead's aſſiſtant at Greenwich, could execute, and it was made by the Exchequer ſtandard of length.

This is confided in by the naturaliſts of Europe as a very accurate ſtandard experiment, and it is confirmed by many others both private and public. The ſtandards of weight and capacity employed in the experiment are ſtill in exiſtence, and publicly known, by the report of the Royal Society to parliament in 1742, and by the report of a committee of the houſe of commons in 1758. This gives it a ſuperiority over all the meaſures which have come to our knowledge.

The firſt experiment, made with proper attention, that we meet with, is by the celebrated Snellius, about the year 1615, and related in his *Eratoſthenes Batavus*. He weighed a Rhinland cubic foot of diſtilled water, and found it 62,79 Amſterdam pounds. If this was the ordinary weight of the ſhops, containing 7626 Engliſh troy grains, the Engliſh cubic foot muſt be 62 pounds 9 ounces, only one ounce more than by Everard's experiment. If it was the Mint pound, the weight was 62 pounds 6 ounces. The only other trials which can come into competition with Mr Everard's are ſome made by the Academy of Sciences at Paris. Picart, in 1691, found the Paris cubic foot of the water of the fountain d'Arcueil to weigh 69,588 pounds *poids de Paris*. DuHamel obtained the very ſame reſult; but Mr Monge, in 1783, ſays that filtered rain-water of the temperature 12° (Reaumur) weighs 69,3792. Both theſe meaſures are conſiderably below Mr Everard's, which is 62,5, the former giving 62,053, and the latter 61,868. M. Lavoiſier ſtates the Paris cubic foot at 70 pounds, which makes the Engliſh foot 62,47. But there is an inconſiſtency among them which makes the compariſon impoſſible. Some changes were made in 1688, by royal authority, in the national ſtandards, both of weight and length; and the academicians are exceedingly puzzled to this day in reconciling the differences, and cannot even aſcertain with perfect aſſurance the lineal meaſures which were employed in their moſt boaſted geodetical operations.

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Such variations in the meaſurements made by perſons of reputation for judgment and accuracy engaged the writer of this article ſome years ago to attempt another. A veſſel was made of a cylindrical form, as being more eaſily executed with accuracy, whoſe height and diameter were 6 inches, taken from a moſt accurate copy of the Exchequer ſtandard. It was weighed in diſtilled water of the temperature 55° ſeveral times without varying 2 grains, and it loſt 42895 grains. This gives for the cubic foot 998,74 ounces, deficient from Mr Everard's an ounce and a quarter; a difference which may be expected, ſince Mr Everard uſed the New River water without diſtillation.

We hope that theſe obſervations will not be thought ſuperfluous in a matter of ſuch continual reference, in the moſt intereſting queſtions both to the philoſopher and the man of buſineſs; and that the determination which we have given will be conſidered as ſufficiently authenticated.

Let us, therefore, for the future take water for the ſtandard, and ſuppoſe that, when of the ordinary temperature of ſummer, and in its ſtate of greateſt natural purity, viz. in clean rain or ſnow, an Engliſh cubic foot of it weighs a thouſand avoirdupois ounces of 437,5 troy grains each. Divide the weight of any body by the weight of an equal bulk of water, the quotient is the ſpecific gravity of that body; and if the three firſt figures of the decimal be accounted integers, the quotient is the number of avoirdupois ounces in a cubic foot of the body. Thus the ſpecific gravity of the very fineſt gold which the refiner can produce is 19,365, and a cubic foot of it weighs 19365 ounces.

But an important remark muſt be made here. All bodies of homogeneous or unorganiſed texture expand by heat and contract by cooling. The expanſion and contraction by the ſame change of temperature is very different in different bodies. Thus water, when heated from 60° to 100°, increaſes its volume nearly $\frac{1}{167}$ of its bulk, and mercury only $\frac{1}{413}$, and many ſubſtances much leſs. Hence it follows, that an experiment determines the ſpecific gravity only in that very temperature in which the bodies are examined. It will therefore be proper always to note this temperature; and it will be convenient to adopt ſome very uſeful temperature for ſuch trials in general: perhaps about 60° of Fahrenheit's thermometer is as convenient as any. It may always be procured in theſe climates without inconvenience. A temperature near to freezing would have ſome advantages, becauſe water changes its bulk very little between the temperature 32° and 45°. But this temperature cannot always be obtained. It will much conduce to the facility of the compariſon to know the variation which heat produces on pure water. The following table, taken from the obſervations of Dr Blagden and Mr Gilpin (Phil. Tranſ. 1792) will anſwer this purpoſe.

Tem-

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Temperature of Water.	Bulk of Water.	Specific Gravity.
30		
35	99910	1,00090
40	99970	1,00094
45	99914	1,00086
50	99932	1,00068
55	99962	1,00038
60	100000	1,00000
65	100050	0,99950
70	100106	0,99894
75	100171	0,99830
80	100242	0,99759
85	100320	0,99681
90	100404	0,99598
95	100501	0,99502
100	100602	0,99402

Thoſe gentlemen obſerved the expanſion of water to be very anomalous between 32° and 45°. This is diſtinctly ſeen during the gradual cooling of water to the point of freezing. It contracts for a while, and then ſuddenly expands. But we ſeldom have occaſion to meaſure ſpecific gravities in ſuch temperature.

The reader is now ſufficiently acquainted with the principles of this hydroſtatical method of determining the ſpecific gravity of bodies, and can judge of the propriety of the forms which may be propoſed for the experiment.

The ſpecific gravity of a fluid may be determined either by filling with it a veſſel with a narrow neck, or by weighing a ſolid body that is immerſed in it. It is hard to ſay which is the beſt way. The laſt is not ſubject to any error in filling, becauſe we may ſuſpend the ſolid by a fine wire, which will not diſplace any ſenſible quantity of the fluid; and if the ſolid is but a little heavier than the fluid, the balance being loaded only with the exceſs, will be very ſenſible to the ſmalleſt want of equilibrium. But this advantage is perhaps compenſated by an obſtruction to the motion of the ſolid up or down in the fluid, ariſing from viſcidity. When the weight in the oppoſite ſcale is yet too ſmall, we ſlowly add more, and at laſt grain by grain, which gradually brings the beam to the level. When it is exactly level, the weight in the ſcale is ſomewhat too great; for it not only balances the preponderance of the ſolid, but alſo this viſcidity of the fluid. But we may get rid of this error. Add a ſmall quantity more; this will bring the beam over to the other ſide. Now put as much into the ſcale on the ſame ſide with the ſolid; this will not reſtore the beam to its level. We muſt add more till this be accompliſhed; and this addition is the meaſure of the viſcidity of the fluid, and muſt be ſubtracted from the weight that was in the other ſcale when the beam came *firſt* to a level. This effect of viſcidity is not inſenſible, with nice apparatus, even in the pureſt water, and in many fluids it is very conſiderable—and, what is worſe, it is very changeable. It is greatly diminiſhed by heat; and this is an additional reaſon for making thoſe trials in pretty warm temperatures. But for fluids of which the viſcidity is conſiderable, this method is by no means proper; and we muſt take the other, and weigh them in a veſſel with a narrow neck. Mercury muſt alſo be treated in this way, becauſe we have no ſolid that will ſink in it but gold and platina. Specific Gravity.

It is not ſo eaſy as one would imagine to fill a veſſel preciſely to the ſame degree upon every trial. But if we do not operate on too ſmall quantities, the unavoidable error may be made altogether inſignificant, by having the neck of the veſſel very ſmall. If the veſſel hold a pound of water, and the neck do not exceed a quarter of an inch (and it will not greatly retard the operation to have it half this ſize), the examinator muſt be very careleſs indeed to err one part in two thouſand; and this is perhaps as near as we can come with a balance. We muſt always recollect that the capacity of the veſſel changes by heat, and we muſt know this variation, and take it into the account. But it is affectation to regard (as Mr Homberg would make us believe that he did) the diſtenſion of the veſſel by the preſſure of the fluid. His experiments of this kind have by no means the conſiſtency with each other that ſhould convince us that he did not commit much greater errors than what aroſe from diſtenſion.

In examining either ſolids or fluids, we muſt be careful to free their ſurface, or that of the veſſel in which the fluid is to be weighed, from air, which frequently adheres to it in a peculiar manner, and, by forming a bubble, increaſes the apparent bulk of the ſolid, or diminiſhes the capacity of the veſſel. The greateſt part of what appears on thoſe occaſions ſeems to have exiſted in the fluid in a ſtate of chemical union, and to be ſet at liberty by the ſuperior attraction of the fluid for the contiguous ſolid body. Theſe air bubbles muſt be carefully bruſhed off by hand. All greaſy matters muſt be cleared off for the ſame reaſon: they prevent the fluid from coming into contact.

We muſt be no leſs careful that no water is imbibed by the ſolid, which would increaſe its weight without increaſing its bulk. In ſome caſes, however, a very long maceration and imbibition is neceſſary. Thus, in examining the ſpecific gravity of the fibrous part of vegetables, we ſhould err exceedingly if we imagined it as ſmall as appears at firſt. We believe that in moſt plants it is at leaſt as great as water, for after long maceration they ſink in it.

It is almoſt needleſs to ſay that the niceſt and moſt ſenſible balances are neceſſary for this examination. Balances are even conſtructed on purpoſe, and fitted with ſeveral pieces of apparatus, which make the examination eaſy and neat. We have deſcribed (ſee BALANCE) Mr Graveſande's as one of the moſt convenient of any. His contrivance for obſerving the fractions of a grain is extremely ingenious and expeditious, eſpecially for detecting the effect of viſcidity.

The hydrometer, or aecometer, is another inſtrument for aſcertaining the ſpecific gravity of fluids. This very pretty inſtrument is the invention of a lady, as eminent for intellectual accompliſhments as ſhe was admired for her beauty. Hypatia, the learned daughter of the celebrated mathematician Theon of Alexandria, became ſo eminent for her mathematical knowledge, that ſhe was made public profeſſor of the ſcience in the firſt ſchool in the world. She wrote a commentary on the works of Apollonius and of Diophantus, and compoſed Aſtronomical Tables; all of which are loſt. Theſe rare

accom-

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accompliſhments, however, could not ſave her from the fury of the fanatics of Alexandria, who cut her in pieces for having taken an offenſive part in a diſpute between the governor and patriarch.—We have deſcribed ſome of the moſt approved of theſe inſtruments in the article HYDROMETER, and ſhall in this place make a few obſervations on the principles of their conſtruction, not as they are uſually made, accommodated to the examination of particular liquors, but as indicators of pure ſpecific gravity. And we muſt premiſe, that this would, for many reaſons, be the beſt way of conſtructing them. The very ingenious contrivances for accommodating them to particular purpoſes are unavoidably attended with many ſources of error, both in their adjuſtment by the maker and in their uſe; and all that is gained by a very expenſive inſtrument is the ſaving the trouble of inſpecting a table. A ſimple ſcale of ſpecific gravity would expoſe to no error in conſtruction, becauſe all the weights but one, or all the points of the ſcale but one, are to be obtained by calculation, which is incomparably more exact than any manual operation, and the table can always be more exact than any complex obſervation. But a ſtill greater advantage is, that the inſtruments would by this means be fitted for examining all liquors whatever, whereas at preſent they are almoſt uſeleſs for any but the one for which they are conſtructed.

Hydrometers are of two kinds. The moſt ſimple and the moſt delicate are juſt a ſubſtitute for the hydroſtatical balance. They conſiſt of a ball (or rather an egg or pear-ſhaped veſſel, which moves more eaſily through the fluid) A (fig. 1.) having a foot projecting down from it, terminated by another ball B, and a ſlender ſtalk or wire above, carrying a little diſh C. The whole is made ſo light as to float in the lighteſt fluid we are acquainted with; ſuch as vitriolic or muriatic æther, whoſe ſpecific gravity is only 0,73. This number ſhould be marked on the diſh, indicating that this is the ſpecific gravity of the fluid in which the inſtrument floats, ſinking to the point D of the ſtem. The ball B is made heavy, and the foot is of ſome length, that the inſtrument may have ſtability, and ſwim erect, even if conſiderably loaded above; and, for the ſame reaſon, it muſt be made very round, otherwiſe it will lean to a ſide. When put into a heavier liquor, its buoyancy will cauſe it to float with a part of the ball above the ſurface. Weights are now put into the ſcale C, till the inſtrument ſink to D. The weight put into the ſcale, added to the weight of the inſtrument, is the weight of the diſplaced fluid. This, compared with the weight of the whole when the inſtrument is ſwimming in pure water, gives the ſpecific gravity of the fluid. All trouble of calculation may be avoided by marking the weights with ſuch numbers as ſhall indicate the ſpecific gravity at once. Thus having loaded the inſtrument ſo as to ſink it to D in pure water, call the whole weight 1000; then weigh the inſtrument itſelf, and ſay, "as the weight when ſwimming in water is to its preſent weight, ſo is 1000 to a 4th proportional." This is the ſpecific gravity of the liquor which would float the unloaded inſtrument. Suppoſe this to be 730. The hydrometer would juſt float in muriatic æther, and this ſhould be marked on the ſide. Now make a ſet of ſmall weights, and mark them, not by their weights in grains, but in ſuch units that 270 of them ſhall be equal to the weight which fits the inſtrument for pure water.

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Suppoſe that, in order to float this inſtrument in a certain brandy, there are required 186 in theſe ſmall weights. This added to 730 gives 916 for the ſpecific gravity, and ſhows it to be preciſely exciſe proof ſpirit. Nine weights, viz. 256, 128, 64, 32, 16, 8, 4, 2, 1, will ſuffice for all liquors from æther to the ſtrongeſt worts. And that the trouble in changing the weights may be greatly leſſened, let a few circles *a*, *b*, *c*, *d*, *e*, be marked on the top of the ball. When we ſee it float unloaded at the circle C for inſtance, we know it will require at leaſt 128 to ſink it to D thaton the ſtem.

If the weights to be added above are conſiderable, it raiſes the centre of gravity ſo much, that a ſmall want of equilibrium, by laying the weights on one ſide, will produce a great inclination of the inſtrument, which is unſightly. Inſtead therefore of making them looſe weights, it is proper to make them round plates, with a ſmall hole in the middle, to go on a pin in the middle of the ſcale. This will keep the inſtrument always upright. But unleſs the hydrometer is of a conſiderable ſize, it can hardly be made ſo as to extend from the lighteſt to the heavieſt fluid which we may have occaſion to examine, even though we except mercury. Some of the mineral acids are conſiderably more than twice the weight of æther. When there is ſuch a load at top, the hydrometer is very apt to overſet, and inclines with the ſmalleſt want of equilibrium. Great ſize is inconvenient even to the philoſopher, becauſe it is not always in his power to operate on a quantity of fluid ſufficient to float the inſtrument. Therefore two, or perhaps three, are neceſſary for general examination. One may reach from æther to water; another may ſerve for all liquors of a ſpecific gravity between 1 and 1½; and the third, for the mineral acids, may reach from this to 2. If each of theſe be about two ſolid inches in capacity, we may eaſily and expeditiouſly determine the ſpecific gravity within one ten thouſandth part of the truth: and this is preciſion enough for moſt purpoſes of ſcience or buſineſs.

Plate CCCCLXXII.

The chief queſtions are, 1. To aſcertain the ſpecific gravity of an unknown fluid. This needs no farther explanation. 2. To aſcertain the proportion of two fluids which are known to be in a mixture. This is done by diſcovering the ſpecific gravity of the mixture by means of the hydrometer, and then deducing the proportion from a compariſon of this with the ſpecific gravities of the ingredients.

In this mode of examination the bulk is always the ſame; for the hydrometer is immerged in the different fluids to the ſame depth. Now if an inch, for example, of this bulk is made up of the heavieſt fluid, there is an inch wanting of the lighteſt; and the change made in the weight of the mixture is the difference between the weight of an inch of the heavieſt and of an inch of the lighteſt ingredients. The number of inches therefore of the heavieſt fluid is proportional to the addition made to the weight of the mixture. Therefore let B and *b* be the bulks of the heavieſt and lighteſt fluids in the bulk β of the mixture; and let D, *d*, and δ be the denſities, or the weights, or the ſpecific gravities (for they are in one ratio)

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ratio) of the heavy fluid, the light fluid, and the mixture (their bulk being that of the hydrometer). We have $\beta = B + b$. The addition which would have been made to the bulk β, if the lighteſt fluid were changed entirely for the heavieſt, would be $D - d$; and the change which is really made is $\delta - d$. Therefore $\beta : b = D - d : \delta - d$. For ſimilar reaſons we ſhould have $\beta : B = D - d : D - \delta$; or, in words, "*the difference between the ſpecific gravities of the two fluids, is to the difference between the ſpecific gravities of the mixture and of the lighteſt fluid, as the bulk of the whole to the bulk of the heavieſt contained in the mixture;*" and "*the difference of the ſpecific gravities of the two fluids, is to the difference of the ſpecific gravities of the mixture and of the heavieſt fluids, as the bulk of the whole to that of the lighteſt contained in the mixture.*" This is the form in which the ordinary buſineſs of life requires the anſwer to be expreſſed, becauſe we generally reckon the quantity of liquors by bulk, in gallons, pints, quarts. But it would have been equally eaſy to have obtained the anſwer in pounds and ounces; or it may be had from their bulks, ſince we know their ſpecific gravities.

The hydrometer more commonly uſed is the ancient one of Hypatia, conſiſting of a ball, A (fig. 2.), made ſteady by an addition B, below it like the former, but having a long ſtem CF above. It is ſo loaded that it ſinks to the top F of the ſtem in the lighteſt of all the fluids which we propoſe to meaſure with it, and to ſink only to C in the heavieſt. In a fluid of intermediate ſpecific gravity it will ſink to ſome point between C and F.

In this form of the hydrometer the weight is always the ſame, and the immediate information given by the inſtrument is that of different bulks with equal weight. Becauſe the inſtrument ſinks till the bulk of the diſplaced fluid equals it in weight, and the additions to the diſplaced fluid are all made by the ſtem, it is evident that equal bulks of the ſtem indicate equal additions of volume. Thus the ſtem becomes a ſcale of bulks to the ſame weight.

The only form in which the ſtem can be made with ſufficient accuracy is cylindrical or priſmatical. Such a ſtem may be made in the moſt accurate manner by wire-drawing, that is, paſſing it through a hole made in a hardened ſteel plate. If ſuch a ſtem be divided into equal parts, it becomes a ſcale of bulks in arithmetical progreſſion. This is the eaſieſt and moſt natural diviſion of the ſcale; but it will not indicate denſities, ſpecific gravities, or weights of the ſame bulk in arithmetical progreſſion. The ſpecific gravity is as the weight divided by the bulk. Now a ſeries of diviſors (the bulks), in arithmetical progreſſion, applied to the ſame dividend (the bulk and weight of the hydrometer as it floats in water), will not give a ſeries of quotients (the ſpecific gravities) in arithmetical progreſſion: they will be in what is called *harmonic progreſſion*, their differences continually diminiſhing. This will appear even when phyſically conſidered. When the hydrometer ſinks a tenth of an inch near the top of the ſtem, it diſplaces one tenth of an inch of a light fluid, compared with that diſplaced by it when it is floating with all the ſtem above the ſurface. In order therefore that the diviſions of the ſtem may indicate equal changes of ſpecific gravity, they muſt be in a ſeries of harmonic progreſſionals increaſing. The point at which the inſtrument floats in pure water ſhould be marked 1000, and thoſe above it 999, 998, 997, &c.; and thoſe below the water mark muſt be numbered 1001, 1002, 1003, &c. Such a ſcale will be a very appoſite picture of the denſities of fluids, for the denſity or vicinity of the diviſions will be preciſely ſimilar to the denſity of the fluids. Each interval is a bulk of fluid of the ſame weight. If the whole inſtrument were drawn out into wire of the ſize of the ſtem, the length from the water mark would be 1000.

Such are the rules by which the ſcale muſt be divided. But there muſt be ſome points of it determined by experiment, and it will be proper to take them as remote from each other as poſſible. For this purpoſe let the inſtrument be accurately marked at the point where it ſtands, in two fluids, differing as much in ſpecific gravity as the inſtrument will admit. Let it alſo be marked where it ſtands in water. Then determine with the utmoſt preciſion the ſpecific gravities of theſe fluids, and put their values at the correſponding points of the ſcale. Then the intermediate points of the ſcale muſt be computed for the different intervening ſpecific gravities, or it muſt be divided from a pattern ſcale of harmonic progreſſionals in a way well known to the mathematical inſtrument-makers. If the ſpecific gravities have been accurately determined, the value 1000 will be found to fall preciſely in the water mark. If we attempt the diviſion entirely by experiment, by making a number of fluids of different ſpecific gravities, and marking the ſtem as it ſtands in them, we ſhall find the diviſions turn out very anomalous. This is however the way uſually practiſed; and there are few hydrometers, even from the beſt maker, that hold true to a ſingle diviſion or two. Yet the method by computation is not more troubleſome; and one ſcale of harmonic progreſſionals will ſerve to divide every ſtem that offers. We may make uſe of a ſcale of equal parts for the ſtem, with the aſſiſtance of two little tables. One of theſe contains the ſpecific gravities in harmonic progreſſion, correſponding to the arithmetical ſcale of bulks on the ſtem of the hydrometer; the other contains the diviſions and fractions of a diviſion of the ſcale of bulks, which correſpond to an arithmetical ſcale of ſpecific gravities. We believe this to be the beſt method of all. The ſcale of equal parts on the ſtem is ſo eaſily made, and the little table is ſo eaſily inſpected, that it has every advantage of accuracy and diſpatch, and it gives, by the way, an amuſing view of the relation of the bulks and denſities.

We have hitherto ſuppoſed a ſcale extending from the lighteſt to the heavieſt fluid. But unleſs it be of a very inconvenient length, the diviſions muſt be very minute. Moreover, when the bulk of the ſtem bears a great proportion to that of the body, the inſtrument does not ſwim ſteady; it is therefore proper to limit the range of the inſtrument in the ſame manner as thoſe of the firſt kind. A range from the denſity of æther to that of water may be very well executed in an inſtrument of very moderate ſize, and two others will do for all the heavier liquors; or an equal range in any other denſities as may ſuit the uſual occupations of the experimenter.

To avoid the inconveniences of a hydrometer with a very long and ſlender ſtem, or the neceſſity of having a ſeries of them, a third ſort has been contrived, in which

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which the principle of both are combined. Suppoſe a hydrometer with a ſtem, whoſe bulk is $\frac{1}{10}$th of that of the ball, and that it ſinks in æther to the top of the ſtem; it is evident that in a fluid which is $\frac{1}{10}$th heavier, the whole ſtem will emerge; for the bulk of the diſplaced fluid is now $\frac{1}{10}$th of the whole leſs, and the weight is the ſame as before, and therefore the ſpecific gravity is $\frac{1}{10}$th greater.

Thus we have obtained a hydrometer which will indicate, by means of diviſions marked on the ſtem, all ſpecific gravities from 0,73 to 0,803; for 0,803 is $\frac{1}{10}$th greater than 0,73. Theſe diviſions muſt be made in harmonic progreſſion, as before directed for an entire ſcale, placing 0,73 at the top of the ſtem and 0,803 at the bottom.

When it floats at the loweſt diviſion, a weight may be put on the top of the ſtem, which will again ſink it to the top. This weight muſt evidently be 0,073, or $\frac{1}{10}$th of the weight of the fluid diſplaced by the unloaded inſtrument. The hydrometer, thus loaded, indicates the ſame ſpecific gravity, by the top of the ſtem, that the unloaded inſtrument indicates by the loweſt diviſion. Therefore, when loaded, it will indicate another ſeries of ſpecific gravities, from 0,803 to 0,8833 (=0,803 + 0,0803), and will float in a liquor of the ſpecific gravity 0,8833 with the whole ſtem above the ſurface.

In like manner, if we take off this weight, and put on 1 = 0,080,3, it will ſink the hydrometer to the top of the ſtem; and with this new weight it will indicate another ſeries of ſpecific gravities from 0,8833 to 0,97163 (= 0,8833 + 0,08833). And, in the ſame manner, a third weight = 08833 will again ſink it to the top of the ſtem, and fit it for another ſeries of ſpecific gravities up to 1,068793. And thus, with three weights, we have procured a hydrometer fitted for all liquors from æther to a wort for a malt liquor of two barrels *per* quarter. Another weight, in the ſame progreſſion, will extend the inſtrument to the ſtrongeſt wort that is brewed.

This is a very commodious form of the inſtrument, and is now in very general uſe for examining ſpirituous liquors, worts, ales, brines, and many ſuch articles of commerce. But the diviſions of the ſcale are generally adapted to the queſtions which naturally occur in the buſineſs. Thus, in the commerce of ſtrong liquors, it is uſual to eſtimate the article by the quantity of ſpirit of a certain ſtrength which the liquor contains.—This we have been accuſtomed to call proof ſpirit, and it is ſuch that a wine gallon weighs 7 pounds 12 ounces; and it is by this ſtrength that the exciſe duties are levied. Therefore the diviſions on the ſcale, and the weights which connect the ſucceſſive repetitions of the ſcale, are made to expreſs at once the number of gallons or parts of a gallon of proof ſpirits contained in a gallon of the liquor. Such inſtruments ſave all trouble of calculation to the exciſeman or dealer; but they limit the uſe of a very delicate and expenſive inſtrument to a very narrow employment. It would be much better to adhere to the expreſſion either of ſpecific gravity or of bulk; and then a very ſmall table, which could be compriſed in the ſmalleſt caſe for the inſtrument, might rendeer ti applicable to every kind of fluid.

The reader cannot but have obſerved that the ſucceſſive weights, by which the ſhort ſcale of the inſtrument is extended to a great range of ſpecific gravities, do not increaſe by equal quantities. Each difference is the weight of the liquor diſplaced by the graduated ſtem of the inſtrument when it is ſunk to the top of the ſcale. It is a determined aliquot part of the whole weight of the inſtrument ſo loaded, (in our example it is always $\frac{1}{11}$th of it). It increaſes therefore in the ſame proportion with the preceding weight of the loaded inſtrument. In ſhort, both the ſucceſſive additions, and the whole weights of the loaded inſtrument, are quantities in geometrical progreſſion; and, in like manner, the diviſions on the ſcale, if they correſpond to equal differences of ſpecific gravity, muſt alſo be unequal.—This is not ſufficiently attended to by themakers; and they commit an error here, which is very conſiderable when the whole range of the inſtrument is great. For the value of one diviſion of the ſcale, when the largeſt weight is on, is as much greater than its value, when the inſtrument is not loaded at all, as the full loaded inſtrument is heavier than the inſtrument unloaded. No manner whatever of dividing the ſcale will correſpond to equal differences of ſpecific gravity through the whole range with different weights; but if the diviſions are made to indicate equal *proportions* of gravity when the inſtrument is uſed without a weight, they will indicate equal *proportions* throughout. This is evident from what we have been juſt now ſaying; for the proportion of the ſpecific gravities correſponding to any two immediately ſucceeding weights is always the ſame.

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The beſt way, therefore, of conſtructing the inſtrument, ſo that the ſame diviſions of the ſcale may be accurate in all its ſucceſſive repetitions with the different weights, is to make theſe diviſions in geometrical progreſſion. The correſponding ſpecific gravities will alſo be in geometric proportion. Theſe being all inſerted in a table, we obtain them with no more trouble than by inſpecting the ſcale which uſually accompanies the hydrometer. This table is of the moſt eaſy conſtruction; for the ratio of the ſucceſſive bulks and ſpecific gravities being all equal, the differences of the logarithms are equal.

This will be illuſtrated by applying it to the example already given of a hydrometer extending from 0,73 to 1,068793 with three weights. This gives four repetitions of the ſcale on the ſtem. Suppoſe this ſcale divided into 10 parts, we have 40 ſpecific gravities.—Let theſe be indicated by the numbers 0, 1, 2, 3, &c. to 40. The mark 0 is affixed to the top of the ſtem, and the diviſions downwards are marked 1, 2, 3, &c. the loweſt being 10. Theſe diviſions are eaſily determined. The ſtem, which we may ſuppoſe 5 inches long, was ſuppoſed to be $\frac{1}{11}$th of the capacity of the ball. It may therefore be conſidered as the extremity of a rod of 11 times its length, or 55 inches; and we muſt find nine mean proportionals between 50 and 55 inches. Subtract each of theſe from 55 inches, and the remainders are the diſtances of the points of diviſion from 0, the top of the ſcale. The ſmalleſt weight is marked 10, the next 20, and the third 30. If the inſtrument loaded with the weight 20 ſinks in ſome liquor to the mark 7, it indicates the ſpecific gravity 27, that is, the 27th of 40 mean proportionals between 0,73 and 1,068793, or 0,944242. To obtain all theſe intermediate ſpecific gravities, we have only to ſubtract 9.8633229, the logarithm

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garithm of 0,73, from that of 1.068793, viz. 0,0288937, and take 0.0041393, the 40th part of the difference. Multiply this by 1, 2, 3, &c. and add the logarithm of 0,73 to each of the products. The ſums are the logarithms of the ſpecific gravities required. Theſe will be found to proceed ſo equably, that they may be interpolated ten times by a ſimple table of proportional parts without the ſmalleſt ſenſible error. Therefore the ſtem may be divided into a hundred parts very ſenſible to the eye (each being nearly the 20th of an inch), and 400 degrees of ſpecific gravity obtained within the range, which is as near as we can examine this matter by any hydrometer. Thus the ſpecific gravities corre-ſponding to n° 26, 27, 28, 29, are as follow:

		1ſt Diff.	2d Diff.
26	0,93529		
		895	
27	0,94424		9
		904	
28	0,95328		9
		913	
29	0,96241		

Nay, the trouble of inſpecting a table may be avoided, by forming on a ſcale the logarithms of the numbers between 7300 and 1068,793, and placing along ſide of it a ſcale of the ſame length divided into 400 equal parts, numbered from 0 to 400. Then, looking for the mark ſhown by the hydrometer on this ſcale of equal parts, we ſee oppoſite to it the ſpecific gravity.

We have been thus particular in the illuſtration of this mode of conſtruction, becauſe it is really a beautiful and commodious inſtrument, which may be of great uſe both to the naturaliſt and to the man of buſineſs.—A table may be compriſed in 20 octavo pages, which will contain the ſpecific gravities of every fluid which can intereſt either, and anſwer every queſtion relative to their admixture with as much preciſion as the obſervations can be made. We therefore recommend it to our readers, and we recommend the very example which we have given as one of the moſt convenient. The inſtrument need not exceed eight inches in length, and may be contained in a pocket caſe of 2 inches broad and as many deep, which will alſo contain the ſcale, a thermometer, and even the table for applying it to all fluids which have been examined.

It is unfortunate that no graduated hydrometer can be made ſo eaſily for the examination of the corroſive mineral acids (A). Theſe muſt be made of glaſs, and we cannot depend on the accurate cylindric form of any glaſs ſtem. But if any ſuch can be procured, the conſtruction is the ſame. The divided ſcale may either be on thin paper paſted on the inſide of the ſtem, or it may be printed on the ſtem itſelf from a plate, with ink made of a metallic calx, which will attach itſelf to the glaſs with a very moderate heat. We would recommend common white enamel, or arſenical glaſs, as the fitteſt material for the whole inſtrument; and the ink uſed, in taking the impreſſion of the ſcale, may be the ſame that is uſed for the low-priced printing on Delft ware pottery.—Firſt form the ſcale on the ſtem. Then, having meaſured the ſolid contents of the graduated part as exactly as poſſible, and determined on the general ſhape of the ball and counterpoiſe below, calculate its ſize, ſo that it may be a little leſs than ten times that of the ſtem. The glaſs-blower can copy this very nearly, and join it to the ſtem. Then make two brines or other liquors, which ſhall have ſpecific gravities in the ratio of 10 to 11. Load the inſtrument ſo that it may ſink to 0 in the lighteſt. When put into the heavieſt, it ſhould riſe to 10. If it does not riſe ſo high, the immerſed part is too ſmall. Let the glaſs blower enlarge the ball of the counterpoiſe a little. Repeat this trial till it be exact. Nothing now remains but to form the weights: And here we obſerve, that when the inſtrument is to have a very great range, as for examining all ſtates of the vitriolic acid, it has a chance of being very tottering when loaded with the greateſt weight on the top of ſo long a ſcale. To avoid this, Mr Quin and others have added ſome of their weights below.—But this will not ſuit the preſent conſtruction, becauſe it will alter the proportion between the bulks of the ſtem and immerſed part. Therefore let theſe weights conſiſt of cylinders of metal ſmall enough to go into the ſtem, and let them be ſoldered to the end of long wires, which will let them go to the bottom, and leave a ſmall hook or ring at top. Theſe can lie alongſide of the inſtrument in its caſe. This is indeed the beſt conſtruction for every hydrometer, becauſe it makes it incomparably more ſteady. The inſtrument is poiſed by ſmall ſhot or mercury. But it will be much better to do it with Newton's fuſible metal (three parts of tin, five parts of lead, and eight parts of biſmuth) in coarſe filings. When the exact quantity has been put in, the inſtrument may be ſet in a veſſel of oil, and this kept on the fire till all is completely melted. It ſoon freezes again, and remains faſt. If this metal is not to be had, let a few bits of ſealing-wax be added to the mercury or ſhot, to make up the counterpoiſe. When heated, it will float a-top, and when it freezes again it will keep all faſt. Thus we ſhall make a very complete and cheap inſtrument.

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There is yet another method of examining the ſpecific gravities of fluids, firſt propoſed by Dr Wilſon, late profeſſor of aſtronomy in the univerſity of Glaſgow. This is by a ſeries of ſmall glaſs bubbles, differing equally, or according to ſome rule, from each other in ſpecific gravity, and each marked with its proper number. When theſe are thrown into a fluid which is to be examined, all thoſe which are heavier than the fluid will fall to the bottom. Then holding the veſſel in the hand, or near a fire or candle, the fluid expands, and one of the floating bubbles begins to ſink. Its ſpecific gravity, therefore, was either equal to, or a little leſs than, that of the fluid; and the degree of the thermometer, when it began to ſink, will inform us how much it was deficient, if we know the law of expanſion of the liquor. Sets of theſe bubbles fitted for the examination of ſpirituous liquors, with a little treatiſe ſhowing the manner of uſing them, and calculating by the thermometer, are made by Mr Brown, an ingenious artiſt of Glaſgow, and are often uſed by the dealers in ſpirits, being found both accurate and expeditious.

Alſo, though a bubble or two ſhould be broken, the ſtrength of ſpirits may eaſily be had by means of the remainder, unleſs two or three in immediate ſucceſſion be

(A) It would be worth while to try copper enamelled.

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be wanting: for a liquor which anſwers to N° 4 will ſink N° 2 by heating it a few degrees, and therefore N° 3 may be ſpared. This is a great advantage in ordinary buſineſs. A nice hydrometer is not only an expenſive inſtrument, but exceedingly delicate, being ſo very thin. If broken or even bruiſed, it is uſeleſs, and can hardly be repaired except by the very maker.

As the only queſtion here is, to determine how many gallons of exciſe proof ſpirits is contained in a quantity of liquor, the artiſt has conſtructed this ſeries of bubbles in the ſimpleſt manner poſſible, by previouſly making 40 or 50 mixtures of ſpirits and water, and then adjuſting the bubbles to theſe mixtures. In ſome ſets the number on each bubble is the number of gallons of proof ſpirits contained in 100 gallons of the liquor. In other ſets the number on each bubble expreſſes the gallons of water which will make a liquor of this ſtrength, if added to 14 gallons of alcohol. Thus, if a liquor anſwers to N° 4, then 4 gallons of water added to 14 gallons of alcohol will make a liquor of this ſtrength. The firſt is the beſt method; for we ſhould be miſtaken in ſuppoſing that 18 gallons, which anſwer to N° 4, contains exactly 14 gallons of alcohol: it contains more than 14, for a reaſon to be given by and by.

By examining the ſpecific gravity of bodies, the philoſopher has made ſome very curious diſcoveries. The moſt remarkable of theſe is the change which the denſity of bodies ſuffers by mixture. It is a moſt reaſonable expectation, that when a cubic foot of one ſubſtance is mixed *any how* with a cubic foot of another, the bulk of the mixture will be two cubic feet; and that 18 gallons of water joined to 18 gallons of oil will fill a veſſel of 36 gallons. Accordingly this was never doubted; and even Archimedes, the moſt ſcrupulous of mathematicians, proceeded on this ſuppoſition in the ſolution of his famous problem, the diſcovery of the proportion of ſilver and gold in a mixture of both. He does not even mention it as a poſtulate that *may* be granted him, ſo much did he conceive it to be an axiom. Yet a little reflection ſeems ſufficient to make it doubtful, and to require examination. A box filled with muſket-balls will receive a conſiderable quantity of ſmall ſhot, and after this a conſiderable quantity of fine ſand, and after this a conſiderable quantity of water. Something like this might happen in the admixture of bodies of porous texture. But ſuch ſubſtances as metals, glaſs, and fluids, where no diſcontinuity of parts can be perceived, or was ſuſpected, ſeem free from every chance of this kind of introſuſception. Lord Bacon, however, without being a naturaliſt or mathematician *ex profeſſo*, inferred from the mobility of fluids that they conſiſted of diſcrete particles, which muſt have pores interpoſed, whatever be their figure. And if we aſcribe the different denſities, or other ſenſible qualities, to difference in ſize or figure of thoſe particles, it muſt frequently happen that the ſmaller particles will be lodged in the interſtices between the larger, and thus contribute to the weight of the ſenſible maſs without increaſing its bulk. He therefore ſuſpects that mixtures will be in general leſs bulky than the ſum of their ingredients.

Accordingly, the examination of this queſtion was one of the firſt employments of the Royal Society of London, and long before its inſtitution had occupied the attention of the gentlemen who afterwards compoſed it. The regiſter of the Society's early meetings contains many experiments on this ſubject, with mixtures of gold and ſilver, of other metals, and of various fluids, examined by the hydroſtatical balance of Mr Boyle. Dr Hooke made a prodigious number, chiefly on articles of commerce, which were unfortunately loſt in the fire of London.

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It was ſoon found, however, that Lord Bacon's conjecture had been well founded, and that bodies changed their denſity very ſenſibly in many caſes. In general, it was found that bodies which had a ſtrong chemical affinity increaſed in denſity, and that their admixture was accompanied with heat.

By this diſcovery it is manifeſt that Archimedes had not ſolved the problem of detecting the quantity of ſilver mixed with the gold in King Hiero's crown, and that the phyſical ſolution of it requires experiments made on all the kinds of matter that are mixed together. We do not find that this has been done to this day, although we may affirm that there are few queſtions of more importance. It is a very curious fact in chemiſtry, and it would be moſt deſirable to be able to reduce it to ſome general laws: For inſtance, to aſcertain what is the proportion of two ingredients which produces the greateſt change of denſity. This is important in the ſcience of phyſics, becauſe it gives us conſiderable information as to the mode of action of thoſe natural powers or forces by which the particles of tangible matter are united. If this introſuſception, concentration, compenetration, or by whatever name it be called, were a mere reception of the particles of one ſubſtance into the interſtices of thoſe of another, it is evident that the greateſt concentration would be obſerved when a ſmall quantity of the recipiend is mixed with, or diſſeminated through, a great quantity of the other. It is thus that a ſmall quantity of fine ſand will be received into the interſtices of a quantity of ſmall ſhot, and will increaſe the weight of the bagful without increaſing its bulk. The caſe is nowiſe different when a piece of freeſtone has grown heavier by imbibing or abſorbing a quantity of water. If more than a certain quantity of ſand has been added to the ſmall ſhot, it is no longer concealed. In like manner, various quantities of water may combine with a maſs of clay, and increaſe its ſize and weight alike. All this is very conceivable, occaſioning no difficulty.

But this is not the caſe in any of the mixtures we are now conſidering. In all theſe, the firſt additions of either of the two ſubſtances produce but an inconſiderable change of general denſity; and it is in general moſt remarkable, whether it be condenſation or rarefaction, when the two ingredients are nearly of equal bulks. We can illuſtrate even this difference, by reflecting on the imbibition of water by vegetable ſolids, ſuch as timber. Some kinds of wood have their weight much more increaſed than their bulks; other kinds of wood are more enlarged in bulk than in weight. The like happens in grains. This is curious, and ſhows in the moſt unqueſtionable manner that the particles of bodies are not in contact, but are kept together by forces which act at a diſtance. For this diſtance between the centres of the particles is moſt evidently ſuſceptible of variation; and this variation is occaſioned by the introduction of another ſubſtance, which, by acting on the particles by attraction or repulſion, diminiſhes or increaſes their mutual actions, and makes new diſtances neceſ-

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neceſſary for bringing all things again into equilibrium. We refer the curious reader to the ingenious theory of the Abbé Boſcovich for an excellent illuſtration of this ſubject (*Theor. Phil. Nat.* § de Solutione Chemica).

This queſtion is no leſs important to the man of buſineſs. Till we know the condenſation of thoſe metals by mixture, we cannot tell the quantity of alloy in gold and ſilver by means of their ſpecific gravity; nor can we tell the quantity of pure alcohol in any ſpirituous liquor, or that of the valuable ſalt in any ſolution of it. For want of this knowledge, the dealers in gold and ſilver are obliged to have recourſe to the tedious and difficult teſt of the aſſay, which cannot be made in all places or by all men. It is therefore much to be wiſhed, that ſome perſons would inſtitute a ſeries of experiments in the moſt intereſting caſes: for it muſt be obſerved, that this change of denſity is not always a ſmall matter; it is ſometimes very conſiderable and paradoxical. A remarkable inſtance may be given of it in the mixture of braſs and tin for bells, great guns, optical ſpeculums, &c. The ſpecific gravity of caſt braſs is nearly 8,006, and that of tin is nearly 7,363. If two parts of braſs be mixed with one of tin, the ſpecific gravity is 8,917; whereas, if each had retained its former bulk, the ſpecific gravity would have been only 7,793 $\left(=\frac{2\times 8{,}006+7{,}363}{3}\right)$. A mixture of equal parts ſhould have the ſpecific gravity 7,684; but it is 8,441. A mixture of two parts tin with one part braſs, inſtead of being 7,577, is 8,027.

In all theſe caſes there is a great increaſe of ſpecific gravity, and conſequently a great condenſation of parts or contraction of bulk. The firſt mixture of eight cubic inches of braſs, for inſtance, with four cubic inches of tin, does not produce 12 cubic inches of bell-metal, but only $10\frac{1}{2}$ nearly, having ſhrunk $\frac{1}{7}$. It would appear that the diſtances of the braſs particles are moſt affected, or perhaps it is the braſs that receives the tin into its pores; for we find that the condenſations in theſe mixtures are nearly proportional to the quantities of the braſs in the mixtures. It is remarkable that this mixture with the lighteſt of all metals has made a compoſition more heavy and denſe than braſs can be made by any hammering.

The moſt remarkable inſtance occurs in mixing iron with platina. If 10 cubic inches of iron are mixed with $1\frac{1}{4}$ of platina, the bulk of the compound is only $9\frac{1}{4}$ inches. The iron therefore has not ſimply received the platina into its pores: its own particles are brought nearer together. There are ſimilar reſults in the ſolution of turbith mineral, and of ſome other ſalts, in water. The water, inſtead of riſing in the neck of the veſſel, when a ſmall quantity of the ſalt has been added to it, ſinks conſiderably, and the two ingredients occupy leſs room than the water did alone.

The ſame thing happens in the mixture of water with other fluids and different fluids with each other: But we are not able to trace any general rule that is obſerved with abſolute preciſion. In moſt caſes of fluids the greateſt condenſation happens when the bulks of the ingredients are nearly equal. Thus, in the mixture of alcohol and water, we have the greateſt condenſation when $16\frac{1}{2}$ ounces of alcohol are mixed with 20 ounces of water, and the condenſation is about $\frac{1}{10}$ of the whole bulk of the ingredients. It is extremely various in different ſubſtances, and no claſſification of them can be made in this reſpect.

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A diſſertation has been publiſhed on this ſubject by Dr Hahn of Vienna, intitled *De Efficacia Mixtionis in mutandis Corporum Voluminibus*, in which all the remarkable inſtances of the variation of denſity have been collected. All that we can do (as we have no directing principle) is to record ſuch inſtances as are of chief importance, being articles of commerce.

The firſt that occurs to us is the mixtures of alcohol and water in the compoſition of ſpirituous liquors. This has been conſidered by many with great care. The moſt ſcrupulous examination of this, or perhaps of any mixture, has been lately made by Dr Blagden (now Sir Charles Blagden) of the Royal Society, on the requiſition of the Board of Exciſe. He has publiſhed an account of the examination in the Philoſophical Tranſactions of London in 1791 and 1792. We ſhall give an account of it under the article *Spirituous Liquors*; and at preſent only ſelect one column, in order to ſhow the condenſation. The alcohol was almoſt the ſtrongeſt that can be produced, and its ſpecific gravity, when of the temperature 60°, was 0,825. The whole mixtures were of the ſame temperature.

Column 1. contains the pounds, ounces, or other meaſures by weight, of alcohol in the mixture. Column 2. contains the pounds or ounces of water. Column 3. is the ſum of the bulks of the ingredients, the bulk of a pound or ounce of water being accounted 1. Column 4. is the obſerved ſpecific gravity of the mixture, taken from Dr Blagden's diſſertation. Column 5. is the ſpecific gravity which would have been obſerved if the ingredients had each retained its own ſpecific gravity. This we calculated by dividing the ſum of the two numbers of the firſt and ſecond columns by the correſponding number of the third. Column 6. is the difference of column 4. and column 5. and exhibits the condenſation.

TABLE.

A.	W.	Volume.	Sp. Gravy obſerved.	Sp. Gravy al culated.	Condenſation.
20	0	24,2424	0,8250	0,8250	00
20	1	25,2424	0,8360	0,8320	40
20	2	26,2424	0,8457	0,8383	74
20	3	27,2424	0,8543	0,8443	100
20	4	28,2424	0,8621	0,8498	123
20	5	29,2424	0,8692	0,8549	143
20	6	30,2424	0,8757	0,8597	160
20	7	31,2424	0,8817	0,8642	175
20	8	32,2424	0,8872	0,8684	188
20	9	33,2424	0,8923	0,8724	199
20	10	34,2424	0,8971	0,8761	216
20	11	35,2424	0,9014	0,8796	218
20	12	36,2424	0,9055	0,8829	226
20	13	37,2424	0,9093	0,8860	233
20	14	38,2424	0,9129	0,8891	238
20	15	39,2424	0,9162	0,8919	243
20	16	40,2424	0,9193	0,8946	247
20	17	41,2424	0,9223	0,8971	252
20	18	42,2424	0,9250	0,8996	254
20	19	43,2424	0,9276	0,9019	257
20	20	44,2424	0,9300	0,9041	259
19	20	43,0303	0,9325	0,9063	262

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A.	W.	Volume.	Sp. Grav^{y} observed.	Sp. Grav^{y} calculated.	Condensation.
18	20	4,81182	0,9349	0,9087	262
17	20	40,6061	0,9375	0,9112	263
16	20	39,3939	0,9402	0,9139	263
15	20	38,1818	0,9430	0,9167	263
14	20	36,9697	0,9458	0,9197	261
13	20	35,7576	0,9488	0,9229	259
12	20	34,5455	0,9518	0,9263	255
11	20	33,3333	0,9549	0,9300	249
10	20	32,1212	0,9580	0,9340	240
9	20	30,9091	0,9612	0,9382	230
8	20	29,6970	0,9644	0,9429	215
7	20	28,4849	0,9675	0,9479	196
6	20	27,2727	0,9707	0,9533	174
5	20	26,0606	0,9741	0,9593	148
4	20	24,8485	0,9777	0,9659	118
3	20	23,6364	0,9818	0,9731	87
2	20	22,4242	0,9865	0,9811	54
1	20	21,2121	0,9924	0,9900	24
0	20	20,0000	1,0000	1,0000	

It is to be remarked, that the condenſation is greateſt when $16\frac{1}{2}$ ounces of alcohol have been added to 20 of water, and the condenſation is $\frac{263}{9183}$, or nearly $\frac{1}{35}$th of the computed denſity. Since the ſpecific gravity of alcohol is 0,825, it is evident that $16\frac{1}{2}$ ounces of alcohol and 20 ounces of water have equal bulks. So that the condenſation is greateſt when the ſubſtances are mixed in equal volumes; and 18 gallons of alcohol mixed with 18 gallons of water will produce not 36 gallons of ſpirits, but 35 only.

We may alſo obſerve, that this is the mixture to which our revenue-laws refer, declaring it to be *one to fix* or *one in ſeven* under proof, and to weigh 7 pounds 13 ounce per gallon. This proportion was probably ſelected as the moſt eaſily compoſed, viz. by mixing equal meaſures of water and of the ſtrongeſt ſpirit which the known proceſſes of diſtillation could produce. Its ſpecific gravity is 0,939 very nearly.

We muſt conſider this elaborate examination of the mixture of water and alcohol as a ſtandard ſeries of experiments, to which appeal may always be made, whether for the purpoſes of ſcience or of trade. The regularity of the progreſſion is ſo great, that in the column which we have examined, viz. that for temperature 60°, the greateſt anomaly does not amount to one part in ſix thouſand. The form of the ſeries is alſo very judiciouſly choſen for the purpoſes of ſcience. It would perhaps have been more directly ſtereometrical had the proportions of the ingredients been ſtated in bulks, which are more immediately connected with denſity. But the author has aſſigned a very cogent reaſon for his choice, viz. that the proportion of bulks varies by a change of temperature, becauſe the water and ſpirits follow different laws in their expanſion by heat.

This is a proper opportunity for taking notice of a miſtake which is very generally made in the concluſions drawn from experiments of this kind. Equal additions of the ſpirit or water produce a ſeries of ſpecific gravities, which decreaſe or increaſe by differences continually diminiſhing. Hence it is inferred that there is a contraction of bulk. Even Dr Lewis, one of our moſt accompliſhed naturaliſts, advances this poſition, in a diſſertation on the pot-aſh of America; and it conſiderably affects his method for eſtimating the ſtrength of the pot-aſh leys. But that it is a miſtake, appears plainly from this, that although we add for ever equal quantities of the ſpirits, we ſhall never produce a *mixture* which has as ſmall a ſpecific gravity as alcohol. Therefore the ſeries of ſucceſſive gravities muſt approximate to this without end, like the ordinates of a hyperbolic curve referred to its aſſymptote.

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That this may appear in the moſt general terms, let w repreſent the weight of the conſtant quantity of water in the mixture, and let a be the weight of the ſmall addition of ſpirits. Alſo let w repreſent the bulk of this quantity of water, and b the bulk of the ſmall addition of alcohol. The weight of the mixture is $w+a$, and its bulk is $w+b$, and its ſpecific gravity is $\frac{w+a}{w+b}$. If we now add a ſecond equal quantity of ſpirits, the weight will be $w+2a$, and if the ſpirit retains its denſity unchanged, the bulk will be $w+2b$, and the ſpecific gravity is $\frac{w+2a}{w+2b}$: and after any number m of ſuch equal additions of ſpirits, the ſpecific gravity will be $\frac{w+ma}{w+mb}$. Divide the numerator of this fraction by its denominator, and the quotient or ſpecific gravity will be $1+\frac{m\times\overline{a-b}}{w+mb}$. This conſiſts of the conſtant part 1, and the variable part $\frac{m(a-b)}{w+mb}$. We need attend only to this part. If its denominator were conſtant, it is plain that the ſucceſſive ſpecific gravities would have equal differences, each being $=\frac{a-b}{w+mb}$, becauſe m increaſes by the continual addition of an unit, and $a-b$ is a conſtant quantity. But the denominator $w+mb$ continually increaſes, and therefore the value of the fraction $\frac{a-b}{w+mb}$ continually diminiſhes.

Therefore the gradual diminution of the increments or decrements of ſpecific gravity, by equal additions of one ingredient to a conſtant meaſure of the other, is not of itſelf an indication of a change of denſity of either of the ingredients; nor proves that in very diluted mixtures a greater proportion of one ingredient is abſorbed or lodged in the interſtices of the other, as is generally imagined. This muſt be aſcertained by comparing each ſpecific gravity with the gravity expreſſed by $1+\frac{w+m(a-b)}{w+mb}$.

This ſeries of ſpecific gravities reſembles ſuch a numerical ſeries as the following, 1; .....; 1,156; 1,163; 1,+69; &c. the terms of which alſo conſiſt of the conſtant integer 1, and the decimal fractions 0,156; 0,163; 0,169; &c. The fraction $\frac{m(a-b)}{w+mb}$ expreſſes this decimal part. Call this d, or make $d=\frac{m(a-b}{w+mb}$. This will give us $b=\frac{ma-wd}{m(1+d)}$. Now a is the weight of the added ingredient, and d is the variable part of the ſpecific gravity obſerved; and thus we learn whe-

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ther *b*, the bulk of the added ingredient, ſuffers any change. We ſhall have occaſion by and by to reſume the conſideration of this queſtion, which is of the firſt moment in the theory of ſpecific gravities, and has great influence in many tranſactions of commerce.

This ſeries of ſpecific gravities is not ſo well fitted for commercial tranſactions. In theſe the uſual queſtion is, how many gallons of alcohol is there in a caſk, or ſome number of gallons of ſpirit? and it is more directly anſwered by means of a table, formed by mixing the ingredients in aliquant parts of one conſtant bulk. The following table, conſtructed from the experiments of Mr Briſſon of the academy of Paris, and publiſhed in the Memoirs for 1769, is therefore inſerted.

W.	A.	Denſity obſerved.	Denſity computed.	Condenſation.	Bulk of 10,000 grains.
0	16	0,8371	0,8371		1,0000
1	15	0,8527	0,8473	63	0,9937
2	14	0,8674	0,8575	115	0,9885
3	13	0,8815	0,8677	157	0,9844
4	12	0,8947	0,8778	189	0,9811
5	11	0,9075	0,8880	214	0,9786
6	10	0,9199	0,8982	235	0,9765
7	9	0,9317	0,9084	251	0,9749
8	8	0,9427	0,9186	256	0,9744
9	7	0,9519	0,9287	243	0,9757
10	6	0,9598	0,9389	217	0,9783
11	5	0,9674	0,9491	189	0,9811
12	4	0,9733	0,9593	144	0,9856
13	3	0,9791	0,9695	99	0,9901
14	2	0,9852	0,9796	57	0,9943
15	1	0,9919	0,9898	21	0,9979
16	0	1,0000	1,0000		1,0000

In this table the whole quantity of ſpirituous liquor is always the ſame. The firſt column is the number of meaſures (gallons, pints, inches, &c.) of water in the mixture; and column 2d gives the meaſures of alcohol. Column 3d is the ſpecific gravity which was obſerved by Mr Briſſon. Column 4th is the ſpecific gravity which would have been obſerved if the ſpirits, or water, or both, had retained their ſpecific denſity unchanged. And the 5th column marks the augmentation of ſpecific gravity or denſity in parts of 10,000. A 6th column is added, ſhowing the bulk of the 16 cubic meaſures of the two ingredients. Each meaſure may be conceived as the 16th part of 10,000, or 625; and we may ſuppoſe them cubic inches, pints, gallons, or any ſolid meaſure.

This table ſcarcely differs from Sir Charles Blagden's; and the very ſmall difference that may be obſerved, ariſes from Mr Briſſon's having uſed an alcohol not ſo completely rectified. Its ſpecific gravity is 0,8371, whereas the other was only 0,8250.

Here it appears more diſtinctly that the condenſation is greateſt when the two ingredients are of equal bulk.

Perhaps this ſeries of ſpecific gravities is as declarative as the other, whether or not there is a change of denſity induced on either of the ingredients. The whole bulk being always the ſame, it is plain that the ſucceſſive equal additions to one of the ingredients is a ſucceſſive equal abſtraction of the other. The change produced, therefore, in the weight of the whole, is the difference between the weight of the ingredient which is taken out and the weight of the equal meaſure of the other which ſupplies its place. Therefore, if neither ingredient changes its denſity by mixture, the weights of the mixtures will be in arithmetical progreſſion. If they are not, there is a variation of denſity in one or both the ingredients.

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We ſee this very clearly in the mixtures of water and alcohol. The firſt ſpecific gravity differs from the ſecond by 156, and the laſt differs from the preceding by no more than 81. Had neither of the denſities changed, the common difference would have been 102. We obſerve alſo, that the augmentation of ſpecific gravity, by the ſucceſſive addition of a meaſure of water, grows leſs and leſs till 12 meaſures of water is mixed with 4 of alcohol, when the augmentation is only 58, and then it increaſes again to 81.

It alſo appears, that the addition of one meaſure of water to a quantity of alcohol produces a greater change of denſity than the mixture of one meaſure of alcohol to a quantity of water. Hence ſome conclude, that the water diſappears by being lodged in the interſtices of the ſpirit. But it is more agreeable to the juſteſt notions which we can form of the internal conſtitution of tangible bodies to ſuppoſe that the particles of water diminiſh the diſtances between the particles of alcohol by their ſtrong attractions, and that this diminution (exceedingly minute in itſelf) becomes ſenſible on account of the great number of particles whoſe diſtances are thus diminiſhed. This is merely a probability founded on this, that it would require a much greater diminution of diſtances if it was the particles of water which had their diſtances thus diminiſhed. But the greater probability is, that the condenſation takes place in both.

We have been ſo particular in our conſideration of this mixture, becauſe the law of variation of denſity has, in this inſtance, been aſcertained with ſuch preciſion by the elaborate examination of Sir Charles Blagden, ſo that it may ſerve as an example of what happens in almoſt every mixture of bodies. It merits a ſtill farther diſcuſſion, becauſe it is intimately connected with the action of the corpuſcular forces; and an exact knowledge of the variations of diſtance between the particles will go far to aſcertain the law of action of theſe forces. But the limits of a Work like this will not permit us to dwell longer on this ſubject. We proceed therefore to give another uſeful table.

The vitriolic or ſulphuric acid is of extenſive uſe in manufactures under the name of oil of vitriol. Its value depends entirely on the ſaline ingredient, and the water is merely a vehicle for the acid. This, being much denſer than water, affects its ſpecific gravity, and thus gives us a method of aſcertaining its ſtrength.

The ſtrongeſt oil of vitriol that can be eaſily manufactured contains $612\frac{1}{10}$ grains of dry acid, united with $387\frac{1}{10}$ grains of water, which cannot be ſeparated from it by diſtillation, making 1000 grains of OIL OF VITRIOL. Its ſpecific gravity in this ſtate is 1,877.

The following table ſhows its ſpecific gravity at the temperature 55°, when diluted by the ſucceſſive addition of parts of water by weight.

Specific

Specific Gravity. Ol. Vit.		Water.	Specific Gravity. Observed.	Calculated.	Cond.
10	×	0	1,877	1,877	,00
		4	1,644	1,501	,143
		8	1,474	1,350	,124
		12	1,381	1,269	,112
		16	1,320	1,219	,101
		20	1,274	1,184	,090
		24	1,243	1,159	,084
		28	1,211	1,140	,071
		32	1,195	1,125	,070
		36	1,183	1,113	,070
		40	1,172	1,103	,070
		50	1,148	1,084	,064
		60	1,128	1,069	,059

Here is obſerved a much greater condenſation than in the mixture of alcohol and water. But we cannot aſſign the proportion of ingredients which produces the greateſt condenſation; becauſe we cannot, in any caſe, ſay what is the proportion of the ſaline and watery ingredients. The ſtrongeſt oil of vitriol is already a watery ſolution; and it is by a conſiderable and uncertain detour that Mr Kirwan has aſſigned the proportion of 612 and 388 nearly. If this be the true ratio, it is unlike every other ſolution that we are acquainted with; for in all ſolutions of ſalts, the ſalt occupies leſs room in its liquid form than it did when ſolid; and here it would be greatly the reverſe.

This ſolution is remarkable alſo for the copious emergence of heat in its dilutions with more water. This has been aſcribed to the great ſuperiority of water in its capacity for heat; but there are facts which render this very doubtful. A veſſel of water, and another of oil of vitriol, being brought from a cold room into a warm one, they both imbibe heat, and riſe in their temperature; and the water employs nearly the ſame time to attain the temperature of the room.

Aquafortis or nitrous acid is another fluid very much employed in commerce; ſo that it is of importance to aſcertain the relation between its ſaline ſtrength and its ſpecific gravity. We owe alſo to Mr Kirwan a table for this purpoſe.

The moſt concentrated ſtate into which it can eaſily be brought is ſuch, that 1000 grains of it conſiſts of 563 grains of water and 437 of dry acid. In this ſtate its ſpecific gravity is 1,557. Let this be called *nitrous acid*.

Nitr. Ac.		Water.			
10	×	0	1,557	1,557	
		1	1,474	1,474	
		6	1,350	1,273	0,077
		11	1,269	1,191	0,078
		16	1,214	1,147	0,067
		21	1,175	1,120	0,055
		26	1,151	1,101	0,050
		31	1,127	1,087	0,040
		36	1,106	1,077	0,029
		41	1,086	1,068	0,018

There is not the ſame uniformity in the denſities of this acid in its different ſtates of dilution. This ſeems owing to the variable proportion of the deleterious and vital air which compoſe this acid. It is more denſe in proportion as it contains more of the latter ingredient. Specific Gravity.

The proportions of the aeriform ingredients of the muriatic acid are ſo very variable, and ſo little under our command, that we cannot frame tables of its ſpecific gravity which would enable us to judge of its ſtrength.

It is a general property of theſe acids, that they are more expanſible by heat as they are more concentrated.

There is another claſs of fluids which it would be of great conſequence to reduce to ſome rules with reſpect to ſpecific gravity, namely, the ſolutions of ſalts, gums, and reſins. It is intereſting to the philoſopher to know in what manner ſalts are contained in theſe watery ſolutions, and to diſcover the relation between their ſtrength and denſity; and to the man of buſineſs it would be a moſt deſirable thing to have a criterion of the quantity of ſalt in any brine, or of extractible matter in a decoction. It would be equally deſirable to thoſe who are to purchaſe them as to thoſe who manufacture or employ them. Perhaps we might aſcertain in this way the value of ſugar, depending on the quantity of ſweetening matter which it contains; a thing which at preſent reſts on the vague determination of the eye or palate. It would therefore be doing a great ſervice to the public, if ſome intelligent perſon would undertake a train of experiments with this view. Accuracy alone is required; and it may be left to the philoſophers to compare the facts, and draw the conſequences reſpecting the internal arrangement of the particles.

One circumſtance in the ſolution of ſalts is very general; and we are inclined, for ſerious reaſons, to think it univerſal: this is a diminution of bulk. This indeed in ſome ſalts is inconſiderable. Sedative ſalt, for inſtance, hardly ſhows any diminution, and might be conſidered as an exception, were it not the ſingle inſtance. This circumſtance, and ſome conſiderations connected with our notions of this kind of ſolution, diſpoſe us to think that this ſalt differs in contraction from others only in degree, and that there is ſome, though it was not ſenſible, in the experiments hitherto made.

Theſe experiments, indeed, have not been numerous. Thoſe of Mr Achard of Berlin, and of Dr Richard Watſon of Cambridge, are perhaps the only ones of which we have a deſcriptive narration, by which we can judge of the validity of the inferences drawn from them. The ſubject is not ſuſceptible of much accuracy; for ſalts in their ſolid form are ſeldom free from cavities and ſhivery interſtices, which do not admit the water on their firſt immerſion, and thereby appear of greater bulk when we attempt to meaſure their ſpecific gravity by weighing them in fluids which do not diſſolve them, ſuch as ſpirits of turpentine. They alſo attach to themſelves, with conſiderable tenacity, a quantity of atmoſpheric air, which merely adheres, but makes no part of their compoſition. This eſcapes in the act of ſolution, being ſet at liberty by the ſtronger affinity of the water. Sal gem, however, and a few others, may be very accurately meaſured; and in theſe inſtances the degree of contraction is very conſtant.

The following experiments of Dr Watſon appear to us the moſt inſtructive as to this circumſtance. A glaſs veſſel was uſed, having a ſlender cylindrical neck, and holding 67 ounces of pure water when filled to a certain

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tain mark. The neck above this mark had a ſcale of equal parts paſted on it. It was filled to the mark with water. Twenty-four pennyweights of ſalt were thrown into it as ſpeedily as poſſible, and the bulk of the ſalt was meaſured by the elevation of the water. Every thing was attended to which could retard the immediate ſolution, that the error ariſing from the ſolution of the firſt particles, before the reſt could be put in, might be as ſmall as poſſible; and in order that both the abſolute bulk and its variations mi ht be obtained by ſome known ſcale, 24 pennyweights of water were put in. This raiſed the ſurface 58 parts of the ſcale. Now we know exactly the bulk of 24 pennyweights of pure water. It is 2,275 cubic inches; and thus we obtain every thing in abſolute meaſures: And by comparing the bulk of each ſalt, both at its firſt immerſion and after its complete ſolution, we obtain its ſpecific gravity, and the change made on it in paſſing from a ſolid to a fluid form. The following table is an abſtract of theſe experiments. The firſt column of numbers is the elevation of the ſurface immediately after immerſion; the ſecond gives the elevation when the ſalt is completely diſſolved; and the third and fourth columns are the ſpecific gravities of the ſalts in theſe two ſtates.

Twenty-four Pennyweights.	I.	II.	III.	IV.
Water -	58			
Glauber's ſalt -	42	36	1,380	1,611
Mild volatile alkali -	40	33	1,450	1,787
Sal ammoniac -	40	39	1,450	1,487
Refined white ſugar -	39	36	1,487	1,611
Courſe brown ſugar -	39	36	1,487	1,611
White ſugarcandy -	37	36	1,567	1,611
Lymington Glauber's ſalt	35	29	1,657	2,000
Terra foliata tartari -	37	30	1,567	1,933
Rochelle ſalt -	33	28	1,757	2,071
Alum not quite diſſolved	33	28	1,757	2,061
Borax not one-half diſſolved in two days -	33	31	1,757	
Green vitriol -	32	26	1,812	2,230
White vitriol -	30	24	1,933	2,416
Nitre - -	30	21	1,933	2,766
Sal gem from Northwich	27	17	2,143	3,411
Blue vitriol -	26	20	2,230	2,900
Pearl aſhes -	25	10	2,320	5,800
Tart. vitriolatus -	22	11	2,636	5,272
Green vitriol calcined to white - -	22	11	2,636	5,272
Dry ſalt of tartar -	21	13	2,761	4,461
Baſket ſea-ſalt -	19	15	3,052	3,866
Corroſive ſublimate -	14	10	4,142	5,800
Turbith mineral -	9	0	6,444	

The inſpecton of this liſt naturally ſuggeſts two ſtates of the caſe as particularly intereſting to the philoſopher ſtudying the theory of ſolution. The firſt ſtate is when the lixivium approaches to ſaturation. In the very point of ſaturation any addition of ſalt retains its bulk unchanged. In diluted brines, we ſhall ſee that the denſity of the fluid ſalt is greater, and gradually diminiſhes as we add more ſalt. It is an important queſtion, Whether this diminution goes on continually, till the fluid denſity of the ſalt is the ſame with its ſolid denſity? or, Whether there is an abrupt paſſage from ſome degree of the one to the fixed degree of the other, as we obſerve in the freezing of iron, the ſetting of ſtucco, and ſome other inſtances? Specific Gravity.

The other intereſting ſtate is that of extreme dilution, when the differences between the ſucceſſive denſities bear a great proportion to the denſities themſelves, and thus enable the mathematician to aſcertain with ſome preciſion the variations of corpuſcular force, in conſequence of a variation of diſtance between the particles. The ſketch of an inveſtigation of this important queſtion given by Boſcovich, in his Theory of Natural Philoſophy, is very promiſing, and ſhould incite the philoſophical chemiſt to the ſtudy. The firſt thing to be done is to compare the law of ſpecific gravity; that is, the relation between the ſpecific gravity and quantity of ſalt held in ſolution.

Wiſhing to make this work as uſeful as poſſible, we have ſearched for experiments, and trains of experiments, on the denſity of the many brines which make important articles of commerce; but we were mortified by the ſcantineſs of the information, and diſappointed in our hopes of being able to combine the detached obſervations, ſuited to the immediate views of their authors, in ſuch a manner as to deduce from them ſcales (as they may be called) of their ſtrength. We rarely found theſe detached obſervations attended with circumſtances which would connect them with others; and there was frequently ſuch a diſcrepancy, nay oppoſition, in ſerieſes of experiments made for aſcertaining the relation between the denſity and the ſtrength, that we could not obtain general principles which enable us to conſtruct tables of ſtrength *à priori*.

Mr Lambert, one of the firſt mathematicians and philoſophers of Europe, in a diſſertation in the Berlin Memoirs (1762), gives a narration of experiments on the brines of common ſalt, from which he deduces a very great condenſation, which he attributes to an abſorption in the weak brines of the ſalt, or a lodgement of its particles in the interſtices of the particles of water. Mr Achard of the ſame academy, in 1785, gives a very great liſt of experiments on the bulks of various brines, made in a different way, which ſhow no ſuch introſuſception; and Dr Watſon, formerly regius profeſſor of chemiſtry at Cambridge, and now biſhop of Landaff, thinks this confirmed by experiments which he narrates in his Chemical Eſſays. We ſee great reaſon for heſitating our aſſent to either ſide, and do not think the experiments deciſive. We incline to Mr Lambert's opinion; for this reaſon, that in the ſucceſſive dilutions of oil of vitriol and aquafortis there is a moſt evident and remarkable condenſation. Now what are theſe but brines, of which we have not been able to get the ſaline ingredient in a ſeparate form? The experiments of Mr Achard and Dr Watſon were made in ſuch a way that a ſingle grain in the meaſurement bore too great a proportion to the whole change of ſpecific gravity. At the ſame time, ſome of Dr Watſon's are ſo ſimple in their nature that it is very difficult to with hold the aſſent.

In this ſtate of uncertainty, in a ſubject which ſeems to us to be of public importance, we thought it our duty to undertake a train of experiments to which recourſe may always be had. Works like this are ſeldom conſidered as ſources of original information; and it is thought ſufficient when the knowledge

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ledge already diffuſed is judiciouſly compiled. But a due reſpect for the public, and gratitude for the very honourable reception hitherto given to our labours, induce us to exert ourſelves with honeſt zeal to merit the continuance of public favour. We aſſure our readers that the experiments were made with care, and on quantities ſufficiently large to make the unavoidable irregularities in ſuch caſes quite inſignificant. The law of denſity was aſcertained in each ſubſtance in two ways. We diſſolved different portions of ſalt in the ſame quantity of water, and examined the ſpecific gravity of the brine by weighing it in a veſſel with a narrow neck. The portions of ſalt were each of them one-eighth of what would make a nearly ſaturated ſolution of the temperature 55. We did not make the brine ſtronger, that there might be no riſk of a precipitation in form of cryſtals. We conſidered the ſpecific gravities as the ordinates of a curve, of which the abſciſſæ were the numbers of ounces of dry ſalt contained in a cubic foot of the brine. Having thus obtained eight ordinates correſponding to 1, 2, 3, 4, 5, 6, 7, and 8 portions of ſalt, the ordinates or ſpecific gravities for every other proportion of ſalt were had by the uſual methods of interpoſition.

The other method was, by firſt making a brine nearly ſaturated, in which the proportion of ſalt and water was exactly determined. We then took out one-eighth of the brine, and filled up the veſſel with water, taking care that the mixture ſhould be complete; for which purpoſe, beſides agitation, the diluted brine was allowed to remain 24 hours before weighing. Taking out one-eighth of the brine alſo takes out one eighth of the ſalt; ſo that the proportion of ſalt and water in the diluted brine was known. It was now weighed, and thus we determined the ſpecific gravity for a new proportion of ſalt and water.

We then took out one-ſeventh of the brine. It is evident that this takes out one-eighth of the original quantity of ſalt; an abſtraction equal to the former. We filled the veſſel with water with the ſame precautions; and in the ſame manner we proceeded till there remained only one-eighth of the original quantity of ſalt.

The ſpecific gravities by theſe two methods agreed extremely well. In the very deliqueſcent ſalts the firſt method exhibited ſome ſmall irregularities, ariſing from the unequal quantities of water which they had imbibed from the atmoſphere. We therefore confided moſt in the experiments made with diluted brines.

That the reader may judge of the authority of the tables which we ſhall inſert, we ſubmit to his inſpection one ſeries of experiments.

Two thouſand one hundred and eighty-eight grains of very pure and dry (but not decrepitated) common ſalt, prepared in large cryſtals, were diſſolved in 6562 grains of diſtilled water of the temperature 55°. A ſmall matraſs with a narrow neck, which held 4200 grains of diſtilled water, was filled with this brine. Its contents weighed 5027 grains. Now $6562 + 2188 : 2188 = 5027 : 1256{,}75$. Therefore the bottle of brine contained 1256,75 grains of ſalt diſſolved in 3770,25 grains of water. Its ſpecific gravity is $= \frac{5027}{4200}$, or 1,196905; and a cubic foot of brine weighs 1196,9 ounces avoirdupois. Alſo $5027 : 1256{,}75 = 1196{,}9 : 299{,}28$. Therefore a cubic foot of this brine contains 299,28 ounces of perfectly dry ſalt.

Specific Gravity.

The ſubſequent ſteps of the proceſs are repreſented as follows.

Salt.	Brine.	Water.	Wt. of Cub. Ft.	Salt in Cub. Ft.
8)1256,75	8)5027	3770,25	1196,9	299,28
157,1	628,4	$=\frac{1}{8}$ of brine.		$37{,}41\frac{1}{8}$
	4398,6	Remains.		
	527,4	Water to fill it again.		
7)1099,6	7)4926,0	2d Brine.	1172,7	261,87
157,1	703,7	$\frac{1}{7}$ taken out.		37,41
	4222,3			
	604,7	Water added.		
942,5	6)4827,0	3d Brine.	1149,3	224,46
157,1	804,5	Taken out.		
	4022,5	Remains.		
	706,5	Water added.		
785,4	5)4729,0	4th Brine.	1125,9	187,05
157,1	946	Taken out.		
	3783	Remains.		
	847	Water added.		
628,3	4)4630	5th Brine.	1102,3	149,64
157,1	1157,5	Taken out.		
	3472,5	Remains.		
	1054,5	Water added.		
471,2	3)4527	6th Brine.	1077,9	112,23
157,1	1509	Taken out.		
	3018	Remains.		
	1405	Water added.		
314,1	2)4423	7th Brine.	1053,3	74,82
157,1	2212	Taken out.		
	2211	Remains.		
	2102	Water added.		
157,0	4313	8th Brine.	1027,9	37,41

Thus, by repeated abſtraction of brine, ſo as always to take out $\frac{1}{8}$th of the ſalt contained in one conſtant bulk, we have obtained a brine conſiſting of 157 grains of ſalt united with 4313—157, or 4156 grains of water. Its ſpecific gravity is $\frac{4313}{4200}$, = 1,0279, and a cubic foot of it weighs 1028 ounces, and contains $37\frac{4}{10}$ ounces of dry ſalt. In like manner may the ſpecific gravity, the weight of a cubic foot, and the ſalt it contains, be eſtimated for the intermediate brines.

When theſe eight quantities of ſalt contained in a cubic foot are made the abſciſſæ, and the weights of the cubic foot of brine are the correſponding ordinates, the curve

Spectre. belief of ghoſts may be eaſily deduced from the opinions entertained reſpecting a future ſtate. Theſe opinions are founded on that eſſential doctrine of natural religion, that there is another world in which men ſhall exiſt when death has removed them hence. This doctrine has been univerſally received both by ſavage and civilized nations; but, as might be expected, men have formed very different ſentiments concerning the nature of a future ſtate, of the ſituation and employments of departed ſpirits, according to the degree of knowledge which they poſſeſſed. But the general opinion in ancient and rude nations was, that departed ſpirits retained the ſame external appearance, the ſame paſſions and principles as before. Nothing therefore was more natural than the opinion, that they might occaſionally reviſit this world, from an anxious deſire to alleviate the ſufferings of thoſe beloved friends and relations whom they had left behind them, or to communicate from the unſeen world what might be important to their welfare. Upon ſuch an errand did Creüſa appear to Æneas. The apparition of the ghoſts of murderers is eaſily explained upon the ſame general principles. The remorſe and horror of mind which the murderer feels are ſuppoſed to haunt him in the other world, and to render his ſituation there intolerable (eſpecially if the murder was never detected and puniſhed), till he return and give information againſt himſelf. In this way, then, we think it highly probable the belief of ſpectres has originated. But many other cauſes concur to confirm and propagate this belief. Theſe are, imperfect viſion united with fear, dreams, opium, diſeaſes, drunkenneſs, and artifice.

1. Indiſtinct viſion is one ſource of apparitions, eſpecially when the mind is under the influence of fear. It is well known, that the ſenſe of ſeeing conveys no idea of diſtance till improved by experience and obſervation; and how we come at length to diſtinguiſh objects at a diſtance from thoſe that are near, has been explained in another place (ſee METAPHYSICS, n° 50).

In the day-time we ſeldom commit miſtakes, becauſe we know the object at which we look; but at night, when we ſee objects obſcurely, and know not what they are, we have no diſtinct idea either of their diſtances or of their magnitude. We may miſtake a buſh that is near us for a tree at a diſtance; or if the imagination be under the influence of fear, it will eaſily convert it into a gigantic figure. "It is generally aſſerted (ſays Buffon) that theſe figures exiſt only in the imagination; yet they may have a real exiſtence in the eye; for whenever we have no other mode of judging of an unknown object but by the angle it forms in the eye, its magnitude will uniformly increaſe in proportion to its propinquity. If it appears, when at the diſtance of 20 or 30 paces, to be only a few feet high, its height, when within two or three feet of the eye, will be many fathoms. An object of this kind muſt naturally excite terror and aſtoniſhment in the ſpectator, till he approaches and recogniſes it by actual feeling; for the moment a man knows an object, the gigantic appearance it aſſumed in the eye inſtantly diminiſhes, and its apparent magnitude is reduced to its real dimenſions. But if, inſtead of approaching ſuch an object, the ſpectator flies from it, he can have no other idea of it but from the image which it formed in his eye; and, in this caſe, he may affirm with truth that he ſaw an object terrible in its aſpect, and enormous in its ſize. Thus the notions concerning ſpectres is founded in nature, and depend not, as ſome philoſophers affirm, upon the imagination alone." Spectre.

Buffon's Natural Hiſtory, vol. iii. p. 13.

In addition to theſe obſervations of Buffon, we may take notice, that objects are always magnified in a fog; ſo that when a fog happens in the night-time, objects may be magnified to an enormous ſize. But, at any rate, whether there be fog in the night or not, there is ſuch a great analogy between darkneſs and a fog, that if the latter deceive us with reſpect to the ſize of objects, the former will alſo deceive us. The writer of this article was paſſing the Frith of Forth at Queensferry, near Edinburgh, one morning which was extremely foggy. Though the water be only two miles broad, the boat did not get within ſight of the ſouthern ſhore till it approached very near it. He then ſaw to his great ſurpriſe a large perpendicular rock, where he knew the ſhore was low and almoſt flat. As the boat advanced a little nearer, the rock ſeemed to ſplit perpendicularly into portions, which ſeparated at a little diſtance from one another. He next ſaw theſe perpendicular diviſions move; and upon approaching a little nearer, found it was a number of people ſtanding on the beach, waiting the arrival of the ferry-boat.

2. Dreams are another fertile ſource of apparitions. It is well known to every perſon, that while the mind is under the influence of a dream it conſiders it as much a reality as it does any particular action while awake. Now if a perſon of a weak ſuperſtitious mind ſhould have a very lively dream, which intereſts his paſſions, particularly the paſſion of fear, it may make ſo deep an impreſſion, that he may be firmly convinced that he has actually ſeen with his eyes what has only paſſed before his imagination (See APPARITION) (B). We ſhall here tell a ſtory, by way of illuſtration, which we have received on unqueſtionable authority. An Eaſt Indian captain had an honeſt faithful ſervant named *John*, for whom he had a great regard. John died, if we recollect right, on a voyage from England to the Eaſt Indies during a French war. As the ſhip approached the place of its deſtination the captain had a dream, in which John appeared to him, and earneſtly beſought him not to ſail to the port for which he was bound, as it was in the hands of the French. The captain, though not addicted to ſuperſtition, thought it prudent to follow this admonition; and after landing at a different port, he was informed that the place to which he had intended to ſteer was, according to the information of the dream, captured by the French. On the voyage home, the captain had a ſecond dream, in which John again appeared to him, and gave him no-

(B) When the thoughts are much troubled, and when a perſon ſleeps without the circumſtances of going to bed, or putting off his clothes, as when he nods in his chair, it is very difficult, as Hobbes remarks, to diſtinguiſh a dream from a reality. On the contrary, he that compoſes himſelf to ſleep, in caſe of any uncouth or abſurd fancy, eaſily ſuſpects it to have been a dream.—*Leviathan*, par. i. c. 1.

Spectre. tice that he ſhould ſoon die, and that the ſhip ſhould be taken in the mouth of the Channel by the French. Next morning the captain called his firſt mate, told him his dream, which he believed was prophetic, and delivered his papers, that he might take proper care of them after his deceaſe. Every thing happened exactly as the dream had foretold; the captain died, and the veſſel was taken by a French man of war in the mouth of the Channel. This dream, wonderful as it appears, is eaſily explained. In the voyage out to India, nothing was more natural than that the captain ſhould ſometimes be thinking, that amidſt the various chances of war, the port to which he was bound might be taken; perhaps it was a place of conſequence, which the French might be eager to poſſeſs. The captain being accuſtomed to revolve theſe thoughts in the day-time, they would naturally return at night; the regret which he felt for the loſs of a faithful ſervant might mingle with his apprehenſions, and thus produce the dream. Perhaps the advice was ſuch as John would have given had he been alive. It is equally eaſy to explain the cauſe of the dream in the paſſage home. The captain, we are told, was very ill, and thought himſelf dying, at the very time he had the ſecond dream, and therefore did not expect to reach England. This part of the dream, then, was only his own thoughts, delivered by his ſervant. As to the other part, that his ſhip ſhould be taken in the mouth of the Channel, it may be thought unaccountable how the very place ſhould be foreſeen. But we muſt recollect, that the mouth of the Channel, being over againſt the coaſt of France, was by far the moſt dangerous place in the whole paſſage; and that, therefore, the captain had more reaſon to be afraid of loſing his ſhip there than in any other place. The uſe which we mean to make of this ſtory is this: Had the captain been a man of a weak mind, he would certainly have conſidered the dream as a reality, and believed, that inſtead of having dreamed of the things on which his imagination had dwelled, he had actually ſeen his ſervant return from the dead, and heard him deliver the meſſage. But, on the other hand, the captain, though he believed the dream was prophetic, mentioned it without any ſigns of fear; and no man of courage and reflection ever ſees an apparition. This ſight is reſerved for the weak, the timid, and ſuperſtitious. Of this many inſtances might be mentioned.

3. Spectres are ſometimes alſo occaſioned by opium. Gaſſendi the philoſopher found a number of people going to put a man to death for having intercourſe with the devil; a crime which the poor wretch readily acknowledged. Gaſſendi begged of the people that they would permit him firſt to examine the wizard before putting him to death. They did ſo; and Gaſſendi, upon examination, found that the man firmly believed himſelf guilty of this impoſſible crime. He even offered to Gaſſendi to introduce him to the devil. The philoſopher agreed; and when midnight came, the man gave him a pill, which he ſaid it was neceſſary to ſwallow before ſetting off. Gaſſendi took the pill, but gave it to his dog. The man having ſwallowed his, fell into a profound ſleep; during which he ſeemed much agitated by dreams. The dog was affected in a ſimilar manner. When the man awoke, he congratulated Gaſſendi on the favourable reception he had met with from his ſable highneſs. It was with difficulty Gaſſendi convinced him that the whole was a dream, the effect of ſoporific medicines, and that he had never ſtirred from one ſpot during the whole night. Spectre.

4. That diſeaſes, eſpecially the night-mare, the hypochondria, hyſteric paſſion, and madneſs, are another ſource of ſpectres, we have the ſtrongeſt reaſon to affirm. Perſons ſubject to the night-mare often imagine that they ſee ſpectres. This is ſtill more the caſe with hypochondriac and hyſteric perſons, and thoſe who are in any degree deranged in their intellects. A fact which fell within the obſervation of the writer of this article will both prove and illuſtrate this aſſertion. In a village in one of the midland counties of Scotland, lived a widow diſtinguiſhed among her neighbours for decency of manners, integrity, and reſpect for religion. She affirmed, that for ſeveral nights together ſhe had heard a ſupernatural voice exclaiming aloud, *Murder! murder!* This was immediately reported through the neighbourhood; all were alarmed, and looked around them with ſolicitude for the detection of the murder which they ſuppoſed to have been committed; and it was not long till a diſcovery ſeemed actually to be made. It was reported, that a gentleman, who had relations at no great diſtance, and had been reſiding in the Weſt Indies, had lately arrived with a conſiderable fortune; that he had lodged in an inn about three miles off; and that he had afterwards been ſeen entering a houſe in the village where the widow lived, from which he had never returned. It was next affirmed, that a tradeſman paſſing the church-yard about twelve at midnight had ſeen four men carry a dead corpſe into that cemetery. Theſe three facts being joined together ſeemed perfectly to agree and to confirm one another, and all believed ſome horrible murder had been committed. The relations of the gentleman thought they were called upon to make inquiry into the truth of theſe allegations: they accordingly came firſt to the church-yard, where, in company with the ſexton, they examined all the graves with great care, in order to diſcover whether any of them had been lately dug, or had the appearance of containing more than one coffin. But this ſearch was to no purpoſe, for no alteration had been made upon the graves. It was next reported that the murdered man had been buried in a plantation about a mile diſtant from the village. As the alarm was now very general, a number of the inhabitants propoſed of their own accord to explore it. They accordingly ſpread themſelves over the wood, and ſearched it with care, but no grave nor new dug earth was found. The writer of this article, who was then a boy at ſchool, was along with them. The matter did not reſt here: The perſon who was ſaid to have ſeen four men carry a dead corpſe into the church-yard at midnight was ſummoned to appear before a meeting of the juſtices of the peace. Upon examination he denied any knowledge of the affair, but referred the court to another perſon from whom he had received his information. This perſon was examined, and the reſult was the ſame as the former. In ſhort, one perſon had heard it from another, who had received it from a third, who had heard it from a fourth; but it had received a little embelliſhment from every perſon who

repeated

Spectre. repeated it. It turned out to be the ſame with Smollet's ſtory of the three black crows, which ſome body was ſaid to have vomited.

Upon inquiry at the inn where the Weſt Indian gentleman had lodged, no ſuch gentleman had been ſeen there. It was found afterwards he had never left the Weſt Indies. Still, however, the veracity of the widow was not diſputed; and ſome dark and ſecret tranſaction was ſuſpected. But the whole affair was at length explained by diſcovering that ſhe was ſomewhat deranged by melancholy. And the cries which ſhe had at firſt imagined ſhe had heard were afterwards imitated by ſome roguiſh perſon, who was highly amuſed with ſpreading terror among the credulous.

5. Drunkenneſs alſo has the power of creating ſpectres. Its natural effect in moſt caſes is to derange the underſtanding, to throw it off its guard, and to give full ſcope to that paſſion which has a natural diſpoſition to gain an aſcendancy; and ſometimes it excites paſſions which ſcarcely ſeem to exiſt at any other time. It makes ſome men licentious, ſome furious, ſome all benevolence and kindneſs, ſome from being cowards it renders undaunted heroes. It ſeldom, if ever, excites fear; and therefore it may be thought ſtrange that men ſhould imagine they ſee ghoſts when intoxicated. But it muſt be remarked, that the ghoſts which the drunkard ſees, he ſees not with the ſame alarm and terror as men who are ſober. He is not afraid of them. He has the courage to converſe with them, and even to fight with them, if they give him provocation. A man returning home intoxicated, affirmed that he had met with the devil; and that after a ſevere encounter he had vanquiſhed him and brought him to the ground, to which he had nailed him faſt by driving his ſtaff through his body. Next morning the ſtaff was found ſtuck with great violence into a heap of turfs!

6. Many apparitions of ſpectres have no other origin than the artifices of the waggiſh or ſelf-intereſted. Dr Plot, in his Natural Hiſtory of Oxfordſhire, relates a marvellous ſtory, which will illuſtrate this aſſertion. Soon after the murder of King Charles I. a commiſſion was appointed to ſurvey the king's houſe at Woodſtock, with the manor, park, woods, and other demeſnes to that manor belonging; and one Collins, under a feigned name, hired himſelf as ſecretary to the commiſſioners, who, upon the 13th of October 1649, met, and took up their reſidence in the king's own rooms. His majeſty's bed-chamber they made their kitchen, the council hall their pantry, and the preſence-chamber was the place where they ſat for the diſpatch of buſineſs. His majeſty's dining-room they made their wood-yard, and ſtored it with the wood of the famous royal-oak from the High Park, which, that nothing might be left with the name of king about it, they had dug up by the roots, and ſplit and bundled up into faggots for their firing. Things being thus prepared, they ſat on the 16th of the ſame month for the diſpatch of buſineſs; and in the midſt of their firſt debate there entered a large black dog (as they thought), which made a dreadful howling, overturned two or three of their chairs, and then crept under a bed and vaniſhed. This gave them the greater ſurpriſe, as the doors were kept conſtantly locked, ſo that no real dog could get in or out. The next day their ſurpriſe was increaſed, when ſitting at dinner in a lower room, they heard plainly the noiſe of perſons walking over their heads, though they well knew the doors were all locked, and there could be no body there. Preſently after they heard alſo all the wood of the king's oak brought by parcels from the dining-room, and thrown with great violence into the preſence chamber; as alſo all the chairs, ſtools, tables, and other furniture, forcibly hurled about the room; their papers, containing the minutes of their tranſactions were torn, and the ink-glaſs broken. When all this noiſe had ceaſed, Giles Sharp, their ſecretary, propoſed to enter firſt into theſe rooms; and in preſence of the commiſſioners, from whom he received the key, he opened the doors, and found the wood ſpread about the room, the chairs toſſed about and broken, the papers torn, the ink-glaſs broken (as has been ſaid), but not the leaſt tract of any human creature, nor the leaſt reaſon to ſuſpect one, as the doors were all faſt, and the keys in the cuſtody of the commiſſioners. It was therefore unanimouſly agreed, that the power who did this miſchief muſt have entered the room at the key-hole. The night following, Sharp the ſecretary, with two of the commiſſioners ſervants, as they were in bed in the ſame room, which room was contiguous to that where the commiſſioners lay, had their bed's feet lifted up ſo much higher than their heads, that they expected to have their necks broken, and then they were let fall at once with ſo much violence as ſhook the whole houſe, and more than ever terrified the commiſſioners. On the night of the 19th, as all were in bed in the ſame room for greater ſafety, and lights burning by them, the candles in an inſtant went out with a ſulphureous ſmell, and that moment many trenchers of wood were hurled about the room, which next morning were found to be the ſame their honours had eaten on the day before, which were all removed from the pantry, though not a lock was found opened in the whole houſe. The next night they ſtill fared worſe; the candles went out as before, the curtains of their honours beds were rattled to and fro with great violence; their honours received many cruel blows and bruiſes, by eight great pewter-diſhes and a number of wooden trenchers being thrown on their beds, which being heaved off, were heard rolling about the room, though in the morning none of theſe were to be ſeen. This night likewiſe they were alarmed with the tumbling down of oaken billets about their beds, and other frightful noiſes; but all was clear in the morning, as if no ſuch thing happened. The next night the keeper of the king's houſe and his dog lay in the commiſſioners room, and then they had no diſturbance. But on the night of the 22d, though the dog lay in the room as before, yet the candles went out, a number of brick-bats fell from the chimney into the room, the dog howled piteouſly, their bed clothes were all ſtripped off, and their terror increaſed. On the 24th they thought all the wood of the king's oak was violently thrown down by their bed-ſides; they counted 64 billets that fell, and ſome hit and ſhook the beds in which they lay; but in the morning none were found there, nor had the door been opened where the billet wood was kept. The next night the candles were put out, the curtains rattled, and a dreadful crack like thunder was heard; and one of the ſervants running in haſte, thinking his maſter was killed, found three dozen of trenchers laid ſmoothly under the quilt by him. But all this was nothing to what ſucceeded afterwards: The Spectre.

Spectre. 29th, about midnight, the candles went out, ſomething walked majeſtically through the room, and opened and ſhut the windows; great ſtones were thrown violently into the room, ſome of which fell on the beds, others on the floor; and at about a quarter after one a noiſe was heard as of forty cannon diſcharged together, and again repeated at about eight minutes diſtance. This alarmed and raiſed all the neighbourhood, who coming into their honours room, gathered up the great ſtones, fourſcore in number, and laid them by in the corner of a field, where, in Dr Plot's time, who reports this ſtory, they were to be ſeen. This noiſe, like the diſcharge of cannon, was heard through all the country for 16 miles round. During theſe noiſes, which were heard in both rooms together, the commiſſioners and their ſervants gave one another over for loſt, and cried out for help; and Giles Sharp, ſnatching up a ſword, had well nigh killed one of their honours, miſtaking him for the ſpirit, as he came in his ſhirt from his own room to theirs. While they were together, the noiſe was continued, and part of the tiling of the houſe was ſtript off, and all the windows of an upper room were taken away with it. On the 30th at midnight ſomething walked into the chamber treading like a bear; it walked many times about, then threw the warming-pan violently on the floor; at the ſame time a large quantity of broken glaſs, accompanied with great ſtones and horſes bones, came pouring into the room with uncommon force. Theſe were all found in the morning to the aſtoniſhment and terror of the commiſſioners, who were yet determined to go on with their buſineſs. But on the firſt of November the moſt dreadful ſcene of all enſued: Candles in every part of the room were lighted up, and a great fire made; at midnight, the candles all yet burning, a noiſe like the burſting of a cannon was heard in the room, and the burning billets were toſſed about by it even into their honours beds; who called Giles and his companions to their relief, otherwiſe the houſe had been burnt to the ground; about an hour after the candles went out as uſual, the crack as if many cannon was heard, and many pailfuls of green ſtinking water were thrown upon their honours beds; great ſtones were alſo thrown in as before, the bed curtains and bedſteads torn and broken, the windows ſhattered, and the whole neighbourhood alarmed with the moſt dreadful noiſes; nay, the very rabbit-ſtealers that were abroad that night in the warren were ſo terrified, that they fled for fear and left their ferrets behind them. One of their honours this night ſpoke, and, *in the name of God, aſked what it was, and why it diſturbed them ſo?* No anſwer was given to this; but the noiſe ceaſed for a while, when the ſpirit came again; and, as they all agreed, *brought with it ſeven devils worſe than itſelf.* One of the ſervants now lighted a large candle, and ſet it in the door-way between the two chambers, to ſee what paſſed; and as he watched it, he plainly ſaw a hoof ſtriking the candle and candleſtick into the middle of the room, and afterwards making three ſcrapes over the ſnuff, ſcraped it out. Upon this the ſame perſon was ſo bold as to draw a ſword; but he had ſcarce got it out when he felt another inviſible hand holding it too, and pulling it from him; and at length prevailing, ſtruck him ſo violently on the head with the pummel, that he fell down for dead with the blow. At this inſtant was heard another burſt like the diſcharge of the broadſide of a ſhip of war, and at about a minute or two's diſtance each no leſs than 19 more ſuch: theſe ſhook the houſe ſo violently, that they expected every moment it would fall upon their heads. The neighbours, on this, as has been ſaid, being all alarmed, flocked to the houſe in great numbers, and all joined in prayer and pſalm-ſinging; during which the noiſe ſtill continued in the other rooms, and the diſcharge of cannons was heard as from without, though no viſible agent was ſeen to diſcharge them. But what was the moſt alarming of all, and put an end to their proceedings effectually, happened the next day as they were all at dinner, when a paper, in which they had ſigned a mutual agreement to reſerve a part of the premiſes out of the general ſurvey, and afterwards to ſhare it equally amongſt themſelves, (which paper they had hid for the preſent under the earth in a pot in one corner of the room, and in which an orange-tree grew), was conſumed in a wonderful manner, by the earth's taking fire with which the pot was filled, and burning violently with a blue fume, and an intolerable ſtench; ſo that they were all driven out of the houſe, to which they could never be again prevailed upon to return. Spectre ‖ Speculum.

This wonderful contrivance was all the invention of the memorable Joſeph Collins of Oxford, otherwiſe called *Funny Joe*, who having hired himſelf as ſecretary, under the name of *Giles Sharp*, by knowing the private traps belonging to the houſe, and the help of *pulvis fulminans* and other chemical preparations, and letting his fellow-ſervants into the ſcheme, carried on the deceit without diſcovery to the very laſt; inſomuch that the late Dr Plot, in his Natural Hiſtory, relates the whole for fact, and concludes in this grave manner, "That though tricks have been often played in affairs of this kind, many of the things above related are not reconcileable with juggling; ſuch as the loud noiſes, beyond the power of man to make without ſuch inſtruments as were not there; the tearing and breaking the beds; the throwing about the fire; the hoof treading out the candle; and the ſtriving for the ſword, and the blow the man received from the pummel of it."

SPECULARIS LAPIS, in natural hiſtory, a genus of talcs, compoſed of large plates viſibly ſeparate, and of extreme thinneſs; and each fiſſile again ſeparated into a number of plates ſtill finer. (See TALC.) Of this genus there are three ſpecies: 1. The white ſhining ſpecularis, with large and broad leaves, commonly called *iſinglaſs and Muſcovy glaſs*; its lamellæ, or leaves, are extremely thin, elaſtic, and tranſparent; it makes not the leaſt efferveſcence with aquafortis, and is not eaſily calcined in the fire. It is imported in great quantities; the miniature-painters cover their pictures with it; the lantern-makers ſometimes uſe it inſtead of horn; and minute objects are uſually preſerved between two plates of it, for examination by the microſcope. 2. The bright brown ſpecularis, with broad leaves; a very valuable ſpecies, though inferior to the former. 3. The purple bright ſpecularis, with broad leaves, which is the moſt elegant of all the talcs, and not leſs beautifully tranſparent than the firſt kind.

SPECULATIVE, ſomething relating to the theory of ſome art or ſcience, in contradiſtinction to practical.

SPECULUM for reflecting teleſcopes, is made of a kind of white copper conſiſting of 32 parts fine-

Speculum || Speed.

red copper, 1 of braſs, 15 of grain-tin, and 3 of white arſenic. The proceſs given by the late J. Edwards, who was rewarded by the Board of Longitude for diſcloſing it to the public, was publiſhed in the Nautical Almanack for 1787, and is as follows: Melt the copper in a large crucible, employing ſome black flux, compoſed of two parts of tartar and one of nitre; when melted, add to it the braſs and the ſilver. Let the pure tin be melted in another crucible, alſo with ſome black flux. Take them both from the fire, and pour the melted tin into the fuſed maſs in the large crucible. Stir the whole well with a dry ſpatula of birch, and pour off the fuſed metal immediately into a large quantity of cold water. The ſudden chill of the water will cauſe the fluid metal to divide into an infinite number of ſmall particles, which will cool inſtantly.

Cronſtedt's Mineralogy, vol. ii. p. 712.

2. If the copper be completely ſaturated, the fracture of one piece of this mixed metal will appear bright, and of a gloſſy look, reſembling the face of pure quickſilver. But if it is of a brown reddiſh colour, it wants a little more tin. To aſcertain the required proportion, melt a ſmall quantity, known by weight, of the mixed metal, with a known very ſmall part of tin; and, if neceſſary, repeat the trial with different dozes, till the fracture of the new mixture looks as already deſcribed. Having now aſcertained the neceſſary addition of tin that is required, proceed to the laſt melting of the whole metal, together with the additional proportional doſe of tin; fuſe the whole, obſerving the ſame cautions as before; and you will find that the mixture will melt with a much leſs heat than that for the firſt fuſion. Have ready as many ounces of white arſenic in coarſe powder as there are pounds in the weight of the metal; wrap up the arſenic in a ſmall paper, and put it, with a pair of tongs, into the crucible; ſtir it well with the ſpatula, retaining the breath to avoid the arſenical fumes or vapours (which however are not found to be hurtful to the lungs) till they diſappear; take the crucible off the fire, clear away the droſs from the top of the metal, pour in about one ounce of powdered roſin, with as much nitre, in order to give the metal a clean ſurface, and pour out the metal into the moulded flaſks.

3. The ſpeculum ſhould be moulded with the concave ſurface downwards, and many ſmall holes ſhould be made through the ſand upwards, to diſcharge the air. The moulding ſand from Highgate near London, uſed by the founders, is as good as any for caſting theſe metallic mirrors. The caſt metal ſhould be taken out from the ſand of the flaſks whilſt it is hot, or elſe it may happen to crack if left to cool within. See TELESCOPE.

SPECULUM, a looking glaſs or mirror, capable of reflecting the rays of the ſun.

SPECULUM, in ſurgery, an inſtrument for dilating a wound, or the like, in order to examine it attentively. See SURGERY.

SPEECH, in general, the art or act of expreſſing a perſon's thoughts by means of articulate ſounds, which we call words. See LANGUAGE, GRAMMAR, READING, and ORATORY, part iv.

SPEED (John), an eminent Engliſh hiſtorian, was born at Farington, in Cheſhire, in 1542. He was by profeſſion a taylor, and freeman of the company of merchant-taylors in the city of London. In 1606, he publiſhed his Theatre of Great Britain, which was afterwards reprinted in folio, under the title of the *Theatre of the Empire of Great Britaine*. His Genealogies of Scripture were firſt bound up with the Bible in 1611, when the firſt edition of the preſent tranſlation was printed. In 1614 appeared his *Hiſtory of Great Britaine*, which has been tranſlated into Latin; and in 1616 he publiſhed his *Cloud of Witneſſes*, in octavo. He lived in marriage 57 years with his wife, by whom he had twelve ſons and ſix daughters; and died in 1629. He was interred in the church of St Giles's, Cripplegate, London, where a monument was erected to his memory.

Speedwell || Spelling.

SPEEDWELL, in botany. See VERONICA.

SPELL, a charm conſiſting of ſome words of occult power, generally attended with ſome ceremony.—In order to explain it, we will produce a few examples. On St Agnes's night, 21ſt of January, take a row of pins, and pull out every one, one after another, ſaying a Pater-noſter on ſticking a pin in your ſleeve, and you will dream of him or her you ſhall marry.

Another method to ſee a future ſpouſe in a dream. The party inquiring muſt lie in a different county from that in which he commonly reſides, and on going to bed muſt knit the left garter about the right-legged ſtocking, letting the other garter and ſtocking alone; and as he rehearſes the following verſes, at every comma knit a knot:

Groſe's Provincial Gloſſary.

This knot I knit,
To know the thing I know not yet;
That I may ſee
The man (woman) that ſhall my huſband (wife) be;
How he goes, and what he wears,
And what he does all days and years.

Accordingly, in a dream, he will appear with the inſignia of his trade or profeſſion.

Another, performed by charming the moon, thus: At the firſt appearance of the new moon, immediately after the new year's day, (though ſome ſay any other new moon is as good), go out in the evening, and ſtand over the ſpars of a gate or ſtile, and, looking on the moon, repeat the following lines:

All hail to the moon! all hail to thee!
I prithee, good moon, reveal to me
This night who my huſband (wife) muſt be.

Immediately after you muſt go to bed, when you will dream of the perſon deſtined for your future huſband or wife.

SPELLING, in grammar, that part of orthography which teaches the true manner of reſolving words into their ſyllables.

All words are either ſimple or compound, as *uſe*, *diſuſe*; *done*, *undone*; and the rules for dividing each muſt be ſuch as are derived from the analogy of language in general, or from the eſtabliſhed cuſtom of ſpeaking; which, for the Engliſh language, are reduced to the following rules: 1. A conſonant between two vowels muſt be joined with the latter in ſpelling, as *na-ture*, *ve-ri-ly*, *ge-ne-rous*; except, however, the letter *x*, which is joined to the firſt, as in *flax-en*, *ox-en*, &c. and compound words, as in *up-on*, *un-uſed*, &c. 2. A double conſonant muſt be divided, as in *let-ter*, *man-ner*, &c. 3. Thoſe conſonants which can begin a word muſt not be parted in ſpelling, as in *de-fraud*, re-

Spelman ‖ Spence.

re-prove, *di-ſtinct*; however, this rule is found ſometimes to fail; for though *gn* begins a word, as *gnaw*, *gnat*, &c. yet it muſt be divided in ſpelling, as in *cog-ni-zance*, *ma-lig-ni-ty*, &c. 4. Thoſe conſonants which cannot begin a word muſt be divided, as *ld* in *ſeldom*, *lt* in *mul-ti-tude*, *mp* in *tem-per*, *rd* in *ar-dent*; but in final ſyllables there are exceptions, as *tl* in *ti-tle*, *dl* in *han-dle*, &c. 5. When two vowels come together, and are both of them diſtinctly ſounded, they muſt be ſeparated in ſpelling, as in *co-e-val*, *mu-tu-al*, &c. 6. The grammatical terminations or endings muſt be ſeparated in ſpelling, as *ed* in *wing-ed*, *edſt* in *de-li-ver-edſt*, *ing* in *hear-ing*, *ance* in *de-li-ver-ance*, &c. 7. Compound words muſt be reſolved into their ſimple or component words, as *up-on*, *in-to*, *ne-ver-the-leſs*, *not-with-ſtand-ing*, &c.

SPELMAN (Sir Henry), an eminent Engliſh antiquarian, was deſcended from an ancient family, and born at Cengham, near Lynn in Norfolk, about the year 1561. He was knighted by king James I. who had a particular eſteem for him on account of his known capacity for buſineſs; and he employed him ſeveral times in Ireland on public affairs. When he was about 50 years of age, he went to reſide in London; where falling into a ſtudy to which his own genius had always inclined him, he collected all ſuch books and MSS. as concerned the ſubject of antiquities, either foreign or domeſtic. In 1626, he publiſhed the firſt part of his well-known Gloſſary, which he never carried beyond the letter L; becauſe, as ſome have ſuggeſted, he had ſaid things under "Magna charta," and "Maximum conſilium," that could not then have appeared without giving offence. Upon his death all his papers came into the hands of his ſon Sir John Spelman, a gentleman who had abilities to have completed his father's deſign, if death had not prevented him. The ſecond part was afterwards publiſhed by Sir William Dugdale; but with all the marks of a ſcanty unfiniſhed performance. The next work he entered upon was an edition of the Engliſh Councils, of which he publiſhed the firſt volume about two years before his death, leaving the ſecond volume, as well of this as of his Gloſſary, to be publiſhed by Sir William Dugdale. Sir Henry wrote ſeveral other things, all relating to ancient laws and cuſtoms, and died in 1641. His Poſthumous Works were publiſhed in folio, 1698, under the inſpection of Mr Gibſon, afterwards biſhop of London.

SPELTER, in metallurgy, the ſame with ZINC.

SPENCE (Joſeph), was fellow of New College, Oxford, where he took the degree of A. M. in 1727. About that time he became firſt known as an author, by an *Eſſay on Pope's Odyſſey, in which ſome particular beauties and blemiſhes of that work are conſidered*; a work of great merit, and which for ſound criticiſm and candid diſquiſition is almoſt without a paſallel. He was elected profeſſor of poetry by the univerſity in 1728, and held that office ten years, which is as long as the ſtatutes will allow. His Hiſtory of Stephen Duck was firſt publiſhed in 1731; but it was afterwards much altered, and prefixed to an edition of Duck's poems.

About this time he travelled into Italy as tutor to the earl of Lincoln, afterwards duke of Newcaſtle.—In 1736 he republiſhed Gorboduc, at Mr Pope's deſire, with a preface giving an account of the author, the earl of Dorſet. He quitted his fellowſhip in 1742, upon being preſented by the Society of New College to the rectory of Great Harwood in Buckinghamſhire.—He never reſided in his living; but paid it an annual viſit, diſtributing large ſums of money among the poor, and providing for many of their children. The ſame year he was made profeſſor of modern hiſtory at Oxford. In 1747 he publiſhed *Polymetis*; or an inquiry concerning the agreement between the works of the Roman poets and the remains of ancient artiſts, being an attempt to illuſtrate them mutually from each other. This work was treated by Gray with a contempt which it did not deſerve. He raiſes objections becauſe the author did not illuſtrate his ſubject from Greek writers; that is, becauſe he failed to execute what he never undertook. He was inſtalled prebendary of the ſeventh ſtall at Durham the 24th May 1754. He publiſhed the ſame year, "An Account of the Life, Character, and Poems, of Mr Blacklock, ſtudent of philoſophy at Edinburgh;" which was afterwards prefixed to his Poems. The proſe pieces which he printed in the Muſeum he collected and publiſhed, together with ſome others, in a pamphlet called *Moralities*, by Sir Harry Beaumont. Under the ſame name he publiſhed "Crito, or a dialogue on beauty," and "A particular Account of the Emperor of China's Gardens near Pekin, in a letter from F. Attiret, a French miſſionary now employed by that Emperor to paint the apartments in thoſe gardens, to his friend at Paris." Both theſe treatiſes are printed in Dodſley's fugitive pieces, as is alſo "A Letter from a Swiſs Officer to his friend at Rome;" which Mr Spence firſt publiſhed in the Muſeum. In 1758 he publiſhed "A Parallel, in the Manner of Plutarch, between a moſt celebrated man of Florence and one ſcarce ever heard of in England." This was alſo inſerted in the fugitive pieces. The ſame year he made a journey into Scotland, which he deſcribed in an affectionate letter to Mr Shenſtone, publiſhed in Hall's Collection of Letters, 1778. In 1764 he was very well deſcribed by Mr James Ridley, in his admirable Tales of the Genii, under the name of *Pheſoi Ecneps* (his name read backwards), derviſe of the groves. A letter from Mr Spence to that ingenious moraliſt, under the ſame ſignature, is preſerved in the 3d volume of "Letters of Eminent Perſons." In 1768 he publiſhed "Remarks and Diſſertations on Virgil, with ſome other claſſical obſervations, by the late Mr Holdſworth." On the 20th of Auguſt the ſame year he was unfortunately drowned in a canal in his garden at Byfleet in Surrey. He was found flat upon his face at the edge of the canal, where the water was ſo ſhallow as not even to cover his head. The accident, it was ſuppoſed, for he was quite alone, was owing to a fit.

Spence, Spencer.

The duke of Newcaſtle poſſeſſes ſome manuſcript volumes of anecdotes collected by Mr Spence, from which Dr Johnſon was permitted to inſert many extracts in his Lives of the Poets.

SPENCER (Dr John), an eminent divine, was born in Kent in 1630, and educated at Cambridge. He was choſen fellow of his college, and took a doctor's degree in 1663. In 1667 he was choſen maſter of Corpus Chriſti College, and preferred to the deanery of Ely in 1677. He died on the 20th of May 1695. His works are, 1. The Righteous Ruler; a ſermon on Proverbs xxix. 2. preached June 28. 1660. 2. A Diſcourſe concerning Prodigies, wherein the vanity of preſages by them is reprehended, and their true and proper ends aſſerted and vindicated

Spenſer. vindicated. To this excellent work was afterwards added, A Diſcourſe concerning vulgar prophecies, wherein the vanity of receiving them as the certain indications of any future event is expoſed; and ſome marks of diſtinction between true and pretended prophets are laid down. 3. A Latin Diſſertation concerning Urim and Thummim. 4. His famous treatiſe *De legibus Hebræorum ritualibus et earum rationibus*. The intention of this book, as he informs us himſelf, was to vindicate the Deity from the imputation of acting from arbitrary and fantaſtical motives. It has been highly and juſtly eſteemed both for the elegance of ſtile and the uncommon erudition and ſound ſenſe which it diſplays. It has, however, (that part of it particularly which endeavours to deduce ſome of the Jewiſh ceremonies from the practices of their heathen neighbours), alarmed many perſons, as if ſuch a doctrine, if it could be proved, would derogate from the Divine wiſdom, and undermine revelation. But this is ſo far from being the caſe, that Dr Spencer's attempt, whether ſucceſsful or not, deſerves the gratitude of Chriſtians, becauſe it has a tendency to throw light on an important and difficult ſubject.

SPENSER (Edmund), the poet, was born in London in the year 1553, and deſcended from an ancient family of the Spenſers in Northamptonſhire. All we know concerning his education is, that he was admitted a ſizer of Pembroke-hall in Cambridge, and matriculated in 1569. At this time began his intimacy with Mr Gabriel Harvey, a man of genius and a poet. In 1576, having completed his degrees in arts, he left the univerſity, as it is conjectured, for want of ſubſiſtence, and retired to the north of England. Here he had the misfortune to become enamoured of his Roſalind, who, after flattering his paſſion for a time, at length preferred his happier rival. Spenſer continued in the country till the year 1578, when at the perſuaſion of his friend Mr Harvey he removed to London, where that gentleman introduced him to Mr Sidney (afterwards Sir Philip Sidney). Concerning his firſt introduction to Sir Philip, there is indeed a different ſtory, which was firſt told by the writer of his life, prefixed to his works in 1679, and tranſcribed by Hughes, Cibber, and ſeveral others; which, nevertheleſs, is certainly not true. The purport of it is, that Spenſer, being unknown to this Mecænas of the age, went to Leiceſter-houſe, and ſent in the 9th canto of the firſt book of the Fairy Queen; that, on reading part of it, Sir Philip ordered his ſteward to give the bearer 50 l.; on reading a little farther 50 l. more; then 200 l. bidding him to make haſte and pay the money, leſt he ſhould give the poet his whole eſtate. The ſtory tells prettily enough; but it is very certain, that the Fairy Queen was begun long after his acquaintance with Sir Philip. By this univerſal patron of genius, however, he was preſented to queen Elizabeth, who honoured him with the place of poet-laureat. About this time he finiſhed his Shepherd's Calendar, which was firſt printed in 1579; and in the following year, being recommended by his patron to the earl of Leiceſter, he went to Ireland as ſecretary to the lord Grey of Wilton, then appointed lord-lieutenant of that kingdom. Lord Grey was recalled in 1582, and with him Spenſer returned to London, where he continued till after the death of Sir Philip Sidney in 1586; a loſs which he bewailed to the end of his life. The following year, our poet, having obtained a royal grant of 3000 acres of forfeited lands in the county of Cork in Ireland, ſet out for that kingdom, took poſſeſſion of his eſtate, and fixed his reſidence in the caſtle of Kilcolman, which had belonged to the earl of Deſmond. In this retirement he reſumed his great work of the Fairy Queen; and continued in Ireland till, being viſited by his old friend Sir Walter Raleigh in 1589, he came over with him to England, but returned to Ireland the year following, where he fell in love with a country girl, and married her. Soon after his marriage, he paid another viſit to his native country, where we alſo find him in 1596. In the following year he returned once more to Kilcolman; but on the rebellion of Lord Tyrone, who ravaged the whole county of Cork, he was obliged to fly for ſafety with his family to England, where, in the year 1599, he died in extreme poverty (A). He was buried in Weſtminſter Abbey, according to his requeſt, near Chaucer. A monument was erected to his memory by Ann counteſs of Dorſet. We know but little of his character as a man; as a poet, conſidering the age in which he lived, he deſerves our utmoſt veneration. He wrote various pieces beſides thoſe above-mentioned. His whole works, with his life by Hughes, were publiſhed in ſix volumes 12mo, in 1715 and 1750.

Spenſer, Spergula.

SPERGULA, Spurrey, in botany: A genus of plants belonging to the claſs of *decandria*, and the order of *pentagynia*; and in the natural ſyſtem arranged under the 22d order, *caryophylleæ*. The calyx is pentaphyllous; the petals five, and undivided; the capſule oval, unilocular, and containing five valves. There are five ſpecies, the arvenſis, nodoſa, pentandra, laricina, and ſaginoides; all of which are Britiſh: 1. The *arvenſis*, corn-ſpurrey, has linear furrowed leaves, from eight to twenty in a whirl. The flowers are ſmall, white, and terminal. It is frequent in corn-fields. In Holland it is cultivated as food for cattle, and has the advantage of growing on the very pooreſt ſoils; but does not afford a great deal of food. Poultry are fond of the ſeeds; and the inhabitants of Finland and Norway make bread of them when their crops of corn fail. Horſes, ſheep, goats, and ſwine, eat it. Cows refuſe it.

2. The *nodoſa*, knotted ſpurrey. Several ſtalks ariſe from one root, ſometimes reclining and ſometimes erect, and from three to five inches high. The leaves are ſmooth, of a fine green, narrow, pointed, and oppoſite. The flowers are white, terminal, with yellow antheræ.

3. *Pentandra*, ſmall ſpurrey. The leaves are very narrow, and grow in whirls at the joints. The ſeeds are black with a white circle. It flowers in July.

4. *Laricina*, larch-leaved ſpurrey. Several ſtalks ariſe

(A) This is Camden's account, and it has been generally believed; but Mr Malone, the laſt editor of Shakeſpeare's works, by examining the patent roll, 33 Eliz. p. 3. has diſcovered, that in February 1590-1 Spenſer obtained from Queen Elizabeth an annuity or penſion of L. 50 during his life; a ſum equivalent to L. 200 at preſent.

Sperm, Spermaceti

arise from one root, from an inch to an inch and a half high; the leaves are linear, subulate, and acuminated, somewhat hairy on the edges, and their points turned to one side of the stalk. The petals are white and about the length of the calyx. Lightfoot found this species on a hill in the isle of Bute. He is doubtful whether the *sagina procumbens*, var. β of Linnæus, be not the same plant with this. It flowers in July.

5. *Saginoides*, pearlwort spurrey, has smooth, linear, opposite leaves: the peduncles are solitary and very long. Aiton says it is a native of England, and flowers from June to August.

SPERM, the seed whereof an animal is formed. See Physiology.

SPERMACETI, a whitish, unctuous, flaky substance, prepared from oil, but chiefly from the brains of a species of whale called *physeter macrocephalus*.

The method of preparing spermaceti is kept a secret; but the process is said to be this: The brains being taken out of the animal, are then, as some say, melted over a gentle fire, poured into moulds, and when cold melted again; and this process is continued till they are purified. Others say, that after being pressed and drained they are more thoroughly purified by steeping them in a ley of alkaline salt and quicklime. The brains are then washed, and cut into thin flakes or slices with wooden knives. One fish is said to afford some tons of brains. Good spermaceti is glossy and semitransparent, in fine white flakes; soft and unctuous to the touch, yet dry and friable; in taste, somewhat like butter, and of a faint smell like that of tallow. Some adulterate it with wax; but the deceit is discovered, either by the smell of the wax or by the dulness of the colour. Some also sell a preparation of oil taken from the tail of the whale instead of that from the brain; but this kind turns yellow as soon as exposed to the air. Indeed it is apt in general to grow yellowish, and to contract a rancid fishy smell if not carefully secured from the air. The more perfectly it has been purified at first, the less susceptible it is of these alterations; and after it has been changed, it may be rendered white and sweet again by steeping it afresh in a ley of alkaline salt and quicklime. It melts in a small degree of heat, and congeals again as it cools.

Spermaceti is of use in medicine. Quincy says it is a noble remedy in the asthma, &c. though chiefly used in bruises, inward hurts, and after delivery. For internal use, it may be dissolved in aqueous liquors into the form of an emulsion, by trituration with almonds, the yolk or white of an egg, and more elegantly by mucilages; or made into a lohoch, by mixing two drams of it with a suitable quantity of yolk of egg, then adding half an ounce of fresh drawn oil of almonds, and an ounce of balsamic syrup. Spermaceti is not capable of being dissolved by caustic alkalis, and of forming soaps, like other oily matters: but it is altogether soluble in oils, and unites by liquefaction with wax and resins; and in these forms is applied externally. But it is certain, its greatest property, and that which makes it so much in vogue in many places, is its softening the skin. Whence it comes to be used by the ladies in pastes, washes, &c.

Spermaceti candles are of modern manufacture: they are made smooth, with a fine gloss, free from rings and scars, superior to the finest wax-candles in colour and lustre; and, when genuine, leave no spot or stain on the finest silk, cloth, or linen. Spermacoce ‖ Spey.

A method has been lately proposed by Mr Smith Gibbes of Magdalen college, Oxford, to convert animal muscle into a substance much resembling spermaceti. The process is remarkably simple: Nothing more is necessary than to take a dead carcase and expose it to a stream of running water: it will in a short time be changed to a mass of fatty matter. To remove the offensive smell, a quantity of nitrous acid may then be poured upon it, which uniting with the fetid matter, the fat is separated in a pure state. This acid indeed turns it yellow, but it may be rendered white and pure by the action of the oxygenated muriatic acid. Mr Gibbes brought about the same change in a much shorter time. He took three lean pieces of mutton and poured on them the three mineral acids, and he perceived that at the end of three days each was much altered; that in the nitrous acid was much softened, and on separating the acid from it, he found it to be exactly the same with that which he had before got from the water; that in the muriatic acid was not in that time so much altered; the vitriolic acid had turned the other black. *Phil. Trans.* 1794.

SPERMACOCE, button-wood, in botany: A genus of plants belonging to the class of *tetrandria*, and order of *monogynia*; and in the natural system arranged under the 47th order, *stellatæ*. The corolla is monopetalous and funnel-shaped, and there are two bidentate seeds. The species are eight, tenuior, verticillata, hirta, articularis, stricta, hispida, procumbens, and spinosa.

SPERMATIC, in anatomy, something belonging to the sperm or seed.

SPEUSIPPUS, an Athenian philosopher, the nephew and successor of Plato. Contrary to the practice of Plato, Speusippus required from his pupils a stated gratuity. He placed statues of the graces in the school which Plato had built. On account of his infirm state of health, he was commonly carried to and from the academy in a vehicle. On his way thither he one day met Diogenes, and saluted him; the surly philosopher refused to return the salute, and told him, that such a feeble wretch ought to be ashamed to live; to which Speusippus replied, that he lived not in his limbs, but in his mind. At length, being wholly incapacitated, by a paralytic stroke, for the duties of the chair, he resigned it to Xenocrates. He is said to have been of a violent temper, fond of pleasure, and exceedingly avaricious. Speusippus wrote many philosophical works, which are now lost, but which Aristotle thought sufficiently valuable to purchase at the expence of three talents. From the few fragments which remain of his philosophy, it appears that he adhered very strictly to the doctrine of his master.

SPEY, a river of Scotland, rising from a lake of the same name in Badenoch, and, after a serpentine course of 76 miles, passes by Rothes castle, and falls into the German sea at Garnoch near Elgin. Mr Pennant tells us, that the Spey is a dangerous neighbour to Castle Gordon, overflowing frequently in a dreadful manner, as appears by its ravages far beyond its banks. The bed of the river is wide and full of gravel, and the channel very shifting. In 1746 the duke of Cumberland passed this river at Belly church, near Castle Gordon, when the channel was so deep as to take an officer, from whom

Specific Gravity.

curve will be found to be extremely regular, reſembling a hyperbolic arch whoſe aſſymptote makes an angle of 30° with the axis. Ordinates were then interpolated analytically for every 10 ounces of contained ſalt, and thus the table was conſtructed. We did not, however, reſt it on one ſeries alone; but made others, in which $\frac{1}{4}$th of the ſalt was repeatedly abſtracted. They agreed, in the caſe of common ſalt, with great exactneſs, and in ſome others there were ſome very inconſiderable irregularities.

To ſhow the authority of the tables of ſtrength was by no means our only motive for giving an example of the proceſs. It may be of uſe as a pattern for ſimilar experiments. But, beſides, it is very inſtructive. We ſee, in the firſt place, that there is a very ſenſible change of denſity in one or both of the ingredients. For the ſeries is of that nature (as we have formerly explained), that if the ingredients retained their denſities in every proportion of commixture, the ſpecific gravities would have been in arithmetical progreſſion; whereas we ſee that their differences continually diminiſh as the brines grow more denſe. We can form ſome notion of this by comparing the different brines. Thus in the firſt brine, weighing 5027 grains, there are 3770 grains of water in a veſſel holding 4200. If the denſity of the water remains the ſame, there is left for the ſalt only as much ſpace as would hold 430 grains of water. In this ſpace are lodged 1257 grains of ſalt, and its ſpecific gravity, in its liquid form, is $\frac{1257}{430}$, = 2,8907 very nearly. But in the 8th brine the quantity of water is 4156, the ſpace left for 157 grains of ſalt is only the bulk of 44 grains of water, and the denſity of the ſalt is $\frac{157}{44}$ = 3,568, conſiderably greater than before. This induced us to continue the dilution of the brine as follows, beginning with the 8th brine.

157	2)4313	8th brine
78,5	2156,5	
	2156,5	
	2105,5	
78,5	2)4262,0	9th brine
39,7	2131	
	2131	
	2102	
39,7	2)4233	10th brine
	2116,5	
	2116,5	
	2102	
19,8	4218	11th brine.

This laſt brine contains 4198,2 grains of water, leaving only the bulk of 1,8 grains of water to contain 19,8 of ſalt, ſo that the ſalt is ten times denſer than water. This will make the ſtrength 243 inſtead of 210 indicated by the ſpecific gravity. But we do not pretend to meaſure the denſities with accuracy in theſe diluted brines. It is evident from the proceſs that a ſingle grain of exceſs or defect in taking out the brine and replacing it with water has a ſenſible proportion to the whole variation. But we ſee with ſufficient evidence, that from the ſtrong to the weak brines the ſpace left for the portion of ſalt is continually diminiſhing. In the firſt dilution 527½ grains of water were added to fill up the veſſel; but $\frac{1}{8}$th of its contents of pure water is only 525: ſo that here is a diminution of 2½ grains in the ſpace occupied by the remaining ſalt. The ſubſequent additions are 604,7; 706,5; 847; 1054,5; 1405; 2102; 2105,5; 2102; 2102; inſtead of 600; 700; 840; 1050; 1400; 2100; 2100; 2100; 2100. Nothing can more plainly ſhow the condenſation in general, though we do not learn whether it happens in one or both of the ingredients; nor do the experiments ſhow with ſufficient accuracy the progreſſion of this diminution. The exceſſes of the added water being only ſix or ſeven grains, we cannot expect a nice repartition. When the brine is taken out, the upper part of the veſſel remains lined with a briny film containing a portion of ſalt and water, perhaps equal or ſuperior to the differences. Had our time permitted, we ſhould have examined this matter with ſcrupulous attention, uſing a veſſel with a ſtill narrower neck, and in each dilution abſtracting one half of the brine. The curve, whoſe abſciſſæ and ordinates repreſent the weight of the contained ſalt and the weight of a conſtant bulk of the brine, exhibits the beſt and moſt ſynoptical view of the law of condenſation, becauſe the poſition of the tangent in any point, or the value of the ſymbol $\frac{\dot{x}}{\dot{y}}$, always ſhows the rate at which the ſpecific gravity increaſes or diminiſhes. We are inclined to think that the curve in all caſes is of the hyperbolic kind, and complete; that is, having the tangent perpendicular to the axis at the beginning of the curve. The mathematical reader will eaſily gueſs the phyſical notions which incline us to this opinion; and will alſo ſee that it is hardly poſſible to diſcover this experimentally, becauſe the miſtake of a ſingle grain in the very ſmall ordinates will change the poſition of the tangent many degrees. It was for this reaſon that we thought it uſeleſs to proſecute the dilution any farther. But we think that it may be proſecuted much farther in Dr Watſon's or Mr Achard's method, viz. by diſſolving equal weights of ſalt in two veſſels, of very different capacities, having tubular necks, in which the change of bulk may be very accurately obſerved. We can only conclude, that the condenſation is greateſt in the ſtrongeſt brines, and probably attains its maximum when the quantities of true ſaline matter and water are nearly equal, as in the caſe of vitriolic acid, &c.

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We conſider theſe experiments as abundantly ſufficient for deciding the queſtion "Whether the ſalt can be received into the pores of the water, or the water into the pores of the ſalt, ſo as to increaſe its weight without increaſing its bulk?" and we muſt grant that it may. We do not mean that it is ſimply lodged in the pores as ſand is lodged in the interſtices of ſmall ſhot; but the two together occupy leſs room than when ſeparate. The experiments of Mr Achard were inſufficient for a deciſion, becauſe made on ſo ſmall a quantity as 600 grains of water. Dr Watſon's experiments have, for the moſt part, the ſame defect. Some of them, however, are of great value in this queſtion, and are very fit for aſcer-

Specific Gravity.

taining the ſpecific gravity of diſſolved ſalts. In one of them (not particularly narrated) he found that a quantity of diſſolved ſalt occupied the ſame bulk in two very different ſtates of dilution. We cannot pretend to reconcile this with our experiments. We have given theſe as they ſtood; and we think them concluſive, becauſe they were ſo numerous and ſo perfectly conſiſtent with each other; and their reſult is ſo general, that we have not found an exception. Common ſalt is by no means the moſt remarkable inſtance of condenſation. Vegetable alkali, ſal ammoniac, and ſome others, exhibit much greater condenſation.

We thought this a proper opportunity of conſidering this queſtion, which is intimately connected with the principles of chemical ſolution, and was not perhaps conſidered in ſufficient detail under the article CHEMISTRY. We learn from it in general, that the quantities of ſalt in brines increaſe at ſomewhat a greater rate than their ſpecific gravities. This difference is in many caſes of ſenſible importance in a commercial view. Thus an alkaline lixivium for the purpoſes of bleaching or ſoap-making, whoſe ſpecific gravity is 1,234, or exceeds that of water by 234, contains 361 ounces of ſalt in a cubic foot; a ley, which exceeds the weight of water twice as much, or 468 ounces *per* cubic foot, contains 777 ounces of ſalt, which exceeds the double of 361 by 55 ounces more than 7 *per cent.* Hence we learn, that hydrometers for diſcovering the ſtrength of brines, having equal diviſions on a cylindrical ſtem, are very erroneous; for even if the increments of ſpecific gravity were proportional to the quantities of ſalt in a gallon of brine, the diviſions at the bottom of the ſtem ought to be ſmaller than thoſe above.

The conſtruction of the following table of ſtrengths from the above narrated ſeries of brines is ſufficiently obvious. Column 1ſt is the ſpecific gravity as diſcovered by the balance or hydometer, and alſo is the number of ounces in a cubic foot of the brine. Col. 2d is the ounces of the dry ſalt contained in it.

TABLE of Brines of Common Salt.

Weight Cub. Ft. Brine.	Salt in Cub. F.	Weight Cub. Ft. Brine.	Salt in Cub. F.
1,000	0	1,115	170
1,008	10	1,122	180
1,015	20	1,128	190
1,022	30	1,134	200
1,029	40	1,140	210
1,036	50	1,147	220
1,043	60	1,153	230
1,050	70	1,159	240
1,057	80	1,165	250
1,064	90	1,172	260
1,070	100	1,178	270
1,077	110	1,184	280
1,083	120	1,190	290
1,090	130	1,197	300
1,096	140	1,203	310
1,103	150	1,206	316
1,109	160	1,208	320

The table differs conſiderably from Mr Lambert's. The quantities of ſalt correſponding to any ſpecific gravity are about $\frac{1}{18}$th leſs than in his table. But the reader will ſee that they correſpond with the ſeries of experiments above narrated; and theſe were but a few of many which all correſponded within an hundredth part. The cauſe of the difference ſeems to be, that moſt kinds of common ſalt contain magneſian ſalts, which contain a very great proportion of water neceſſary for their cryſtallization. The ſalt which we uſed was of the pureſt kind, but ſuch as may be had from every ſalt work, by Lord Dundonald's very eaſy proceſs, viz. by paſſing through it a ſaturated ſolution boiling hot, which carries off with it about $\frac{4}{5}$ths of all the bitter ſalts. Our aim being to aſcertain the quantities of pure ſea-ſalt, and to learn by the by its relation to water in reſpect of denſity, we thought it neceſſary to uſe the pureſt ſalt. We alſo dried it for ſeveral days in a ſtove, ſo that it contained no water not abſolutely neceſſary for its cryſtallization. An ounce of ſuch ſalt will communicate a greater ſpecific gravity to water than an ounce of a ſalt that is leſs pure, or that contains extraneous water.

Specific Gravity.

The ſpecific gravity 1,090 is that of ordinary pickles, which are eſtimated as to ſtrength by floating an egg.

We cannot raiſe the ſpecific gravity higher than 1,206 by ſimply diſſolving ſalt in cold water. But it will become much denſer, and will even attain the ſpecific gravity 1,240 by boiling, then holding about 366 ounces in the cubic foot of hot brine. But it will depoſit by cooling, and when of the temperature 55° or 60°, hardly exceeds 1,206. We obtained a brine by boiling till the ſalt grained very rapidly. When it cooled to 60°, its ſpecific gravity was 1,2063; for a veſſel which held 3506 grains of diſtilled water held 4229 of this brine. This was evaporated to dryneſs, and there were obtained 1344 grains of ſalt. By this was computed the number interpoſed between 310 and 320 in the table. We have however raiſed the ſpecific gravity to 1,217, by putting in no more ſalt than was neceſſary for this denſity, and uſing heat. It then cooled down to 60° without quitting any ſalt; but if a few grains of ſalt be thrown into this brine, it will quickly depoſit a great deal more, and its denſity will decreaſe to 1,206. We find this to hold in all ſalts; and it is a very inſtructive fact in the theory of cryſtallization; it reſembles the effect which a magnet produces upon iron filings in its neighbourhood. It makes them temporary magnets, and cauſes them to arrange themſelves as if they had been really made permanent magnets. Juſt ſo a cryſtal already formed diſpoſes the reſt to cryſtallize. We imagine that this analogy is complete, and that the forces are ſimilar in both caſes.

The above table is computed for the temperature 55°; but in other temperatures the ſtrength will be different on two accounts, viz. the expanſion of the brine and the diſſolving power of the water. Water expands about 40 parts in 1000 when heated from 60° to 212°. Saturated brine expands about 48 parts, or $\frac{1}{5}$th more than water; and this exceſs of expanſion is nearly proportional to the quantity of ſalt in the brine. If therefore any circumſtance ſhould oblige us to examine a brine in a temperature much above 60°, allowance ſhould be made for this. Thus, ſhould the ſpecific gravity of brine of the temperature 130 (which is nearly half way between 60 and 212) be 1,140, we muſt increaſe it by 20 (half of 40); and having found the ſtrength 240 correſponding to this corrected ſpecific gravity, we muſt correct it again by adding 1 to the ſpecific gravity for every 45 ounces of ſalt.

Specific Gravity.

But a much greater and more uncertain correction is neceſſary on account of the variation of the diſſolving power of water by heat. This indeed is very ſmall in the caſe of ſea-ſalt in compariſon with other ſalts. We preſume that our readers are appriſed of this peculiarity of ſea-ſalt, that it diſſolves nearly in equal quantities in hot or in cold water. But although water of the temperature 60 will not diſſolve more than 320 or 325 ounces of the pureſt and dryeſt ſea-ſalt, it will take up above 20 ounces more by boiling on it. When thus ſaturated to the utmoſt, and allowed to cool, it does not quit any of it till it is far cooled, viz. near to 60°. It then depoſits this redundant ſalt, and holds the reſt till it is juſt going to freeze, when it lets it go in the inſtant of freezing. If evaporated in the ſtate in which it continues to hold the ſalt, it will yield above 400 ounces *per* cubic foot of brine, in good cryſtals, but rather overcharged with water. And ſince in this ſtate the cubic foot of brine weighs about 1220 ounces, it follows, that 820 ounces of water will, by boiling, diſſolve 400 of cryſtallized ſalt.

The table ſhows how much any brine muſt be boiled down in order to grain. Having obſerved its ſpecific gravity, find in the table the quantity of ſalt correſponding. Call this x. Then, ſince a boiling hot graining or ſaturated ſolution contains 340 ounces in the cubic foot of brine, ſay $340 : 1000 = x : \frac{1000}{340}x$. This is the bulk to which every cubic foot (valued at 1000) muſt be boiled down. Thus ſuppoſe the brine has the ſpecific gravity 1109. It holds 160 ounces *per* foot, and we muſt boil it down to $\frac{1000 \times 160}{340}$ or 471; that is, we muſt boil off $\frac{529}{1000}$ of every cubic foot or gallon.

Theſe remarks are of importance in the manufacture of common ſalt; they enable us to appretiate the value of ſalt ſprings, and to know how far it may be prudent to engage in the manufacture. For the doctrine of latent heat aſſures us, that in order to boil off a certain quantity of water, a certain quantity of heat is indiſpenſably neceſſary. After the moſt judicious application of this heat, the conſumption of fuel may be too expenſive.

The ſpecific gravity of ſea-water in theſe climates does not exceed 1,03, or the cubic foot weighs 1030 ounces, and it contains about 41 ounces of ſalt. The brine-pits in England are vaſtly richer; but in many parts of the world brines are boiled for ſalt which do not contain above 10 or 20 ounces in the cubic foot.

In buying ſalt by weight, it is of importance to know the degree of humidity. A ſalt will appear pretty dry (if free from magneſia ſalts) though moiſtened with 1 *per cent.* of water; and it is found that incipient humidity expoſes it much to farther deliqueſcence. A much ſmaller degree of humidity may be diſcovered by the ſpecific gravity of a brine made with a few ounces of the ſalt. And the inſpection of the table informs us that the brine ſhould be weak; for the differences of ſpecific gravity go on diminiſhing in the ſtronger brines: 300 ounces of dry ſalt diſſolved in 897 ounces of water ſhould give the ſpecific gravity 1197. Suppoſe it be but 1190, the quantity of ſalt correſponding is only 290; but when mixed with 897 ounces of water, the weight is 1197, although the weight of the cubic foot is only 1190. There is therefore more than a cubic foot of the brine, and there is as much ſalt as will make more than a cubic foot of the weight 1190. There is $290 \times \frac{1197}{1190}$, or $291\frac{1}{7}$ ounces, and there is $8\frac{1}{7}$ ounces of water attached to the ſalt.

Specific Gravity.

The various informations which we have pointed out as deducible from a knowledge of the ſpecific gravity of the brines of common ſalt, will ſerve to ſuggeſt ſeveral advantages of the knowledge of this circumſtance in other lixivia. We ſhall not therefore reſume them, but ſimply give another table or two of ſuch as are moſt intereſting. Of thoſe alkaline leys are the chief, being of extenſive uſe in bleaching, ſoap-making, glaſs-making, &c.

We therefore made a very ſtrong ley of the pureſt vegetable alkali that is ever uſed in the manufactories, not thinking it neceſſary, or even proper, to take it in its ſtate of utmoſt purity, as obtained from cubic nitre and the like. We took ſalt of tartar from the apothecary, perfectly dry, of which 3983 grains were diſſolved in 3540 grains of diſtilled water; and after agitation for ſeveral days, and then ſtanding to depoſit ſediment, the clear ley was decanted. It was again agitated; becauſe, when of this ſtrength, it becomes, in a very ſhort time, rarer above and denſer at the bottom. A flaſk containing 4200 grains of water held 6165 of this ley when of the temperature 55°. Its ſpecific gravity was therefore 1,4678, and the 6165 grains of ley contained 3264 grain of ſalt. We examined its ſpecific gravity in different ſtates of dilution, till we came to a brine containing 51 grains of ſalt, and 4189 grains of water, and the contents of the flaſk weighed 4240 grains: its ſpecific gravity was therefore 1,0095. In this train of experiments the progreſſion was moſt regular and ſatisfactory; ſo that when we conſtructed the curve of ſpecific gravities geometrically, none of the points deviated from a moſt regular curve. It was conſiderably more incurvated near its commencement than the curve for ſea-ſalt, indicating a much greater condenſation in the diluted brines. We think that the following table, conſtructed in the ſame manner as that for common ſalt, may be depended on as very exact.

Weight of Cub. Foot oz.	Salt cont. oz.	Weight of Cub. Foot oz.	Salt cont. oz.	Weight of Cub. Foot oz.	Salt cont. oz.
1000	0	1224	340	1417	680
1016	20	1236	360	1428	700
1031	40	1248	380	1438	720
1045	60	1259	400	1449	740
1058	80	1270	420	1460	760
1071	100	1281	440	1471	780
1084	120	1293	460	1482	800
1098	140	1305	480	1493	820
1112	160	1317	500	1504	840
1125	180	1329	520	1515	860
1138	200	1340	540	1526	880
1150	220	1351	560	1537	900
1162	240	1362	580	1547	920
1174	260	1372	600	1557	940
1187	280	1384	620	1567	960
1200	300	1395	640	1577	980
1212	320	1406	660	1586	1000

Specific Gravity.

We ſee the ſame augmentation of the denſity of the ſalt in the diluted brines here as in the caſe of common ſalt. Thus a brine, of which the cubic foot weighs 1482 ounces, or which has the ſpecific gravity 1,482, contains 800 ounces of dry alkali and 682 of water. Therefore, if we ſuppoſe the denſity of the water unchanged, there remains the bulk of 318 ounces of water to receive 840 ounces of ſalt: its denſity is therefore $\frac{800}{318}$, = 2,512 nearly. But in the brine whoſe weight *per* foot is only 1016 there are 20 ounces of ſalt, and therefore 996 of water; and there is only four ounce-meaſures of water, that is, the bulk of four ounces of water, to receive 20 ounces of ſalt. Its ſpecific gravity therefore is $\frac{20}{4}$, = 5, almoſt twice as great as in the ſtrong brine. Accordingly Mr Achard is diſpoſed to admit the abſorption (as it is careleſsly termed) in the caſe of ſal tart. But it is a general (we think an univerſal) fact in the ſolution of ſalts. It muſt be carefully diſtinguiſhed from the firſt contraction of bulk which ſalts undergo in paſſing from a ſolid to a fluid form. The contraction now under conſideration is analogous to the contraction of oil of virtriol when diluted with water; for oil of vitriol muſt be conſidered as a very ſtrong brine which we cannot dephlegmate by diſtillation, and therefore cannot obtain the dry ſaline ingredient in a ſeparate form, ſo as to obſerve its ſolid denſity, and ſay how much it contracts in firſt becoming fluid. The way of conceiving the firſt contraction in the act of ſolution as a lodging of the particles of the one ingredient on the interſtices of the other, "*ou ils ſe nichent, en augmentant le poids ſans affecter le volume de la ſaumure*," as Eller and Lambert expreſs themſelves, is impoſſible here, when both are fluids. Indeed it is but a ſlovenly way of thinking in either caſe, and ſhould be avoided, becauſe inadvertent perſons are apt to uſe as a phyſical principle what is merely a mode of ſpeech.

We learn from the table, that a hydrometer with equidiſtant diviſions on a cylindrical or priſmatical ſtem is ſtill more erroneous than in the brines of common ſalt.

We learn from the experiments of Kirwan, Lavoiſier, and others, that dry ſalt of tartar contains about $\frac{1}{4}$th of its weight of fixed air. In many applications of this ſalt to the purpoſes of manufacture, this ingredient is of no uſe. In ſome it is hurtful, and muſt be abſtracted by lime. Soap-maker's ley conſiſts of the pure alkaline ſalt diſſolved in water. It is therefore of importance to aſcertain its quantity by means of the ſpecific gravity of the brine. For this purpoſe, we took a ley of ſal tart. whoſe ſpecific gravity was 1,20417, containing 314 oz. of mild alkali in a cubic foot of ley, and we rendered it nearly cauſtic by lime. The ſpecific gravity was then 1,1897. This is a very unexpected reſult. Nothing is employed with more ſucceſs than quicklime for dephlegmating any watery fluid. We ſhould rather have expected an increaſe of ſpecific gravity by the abſtraction of ſome of the water of the menſtruum, and perhaps the water of the cryſtallization, and the aerial part of the ſalt. But we muſt aſcribe this to the great denſity in which the fixed air exiſts in the mild alkali.

It is unneceſſary to give ſimilar tables for all the ſalts, unleſs we were writing a diſſertation on the theory of their ſolution. We ſhall only obſerve, that we examined with particular attention ſal ammoniac, becauſe Mr Achard, who denies what is called the abſorption of ſalts, finds himſelf obliged to allow ſomething like it in this ſalt. It does not, however, differ from thoſe of which we have given an account in detail in any other reſpect than this, that the changes of fluid denſity are much leſs than in others (inſtead of being greater, as Achard's experiments ſeem to indicate) in all brines of moderate ſtrength. But in the very weak brines there is indeed a remarkable difference; and if we have not committed an error in our examination, the addition of one part of ſal ammoniac to 64 of water occupies leſs room than the water alone. We think that we have met with this as an accidental remark by ſome author, whoſe work we do not recollect. But we do not chooſe to reſt ſo much on our form of the experiment in ſuch weak brines. The following mixtures will abundantly ſerve for conſtructing the table of its ſtrength: Sal ammoniac = 960 grains was diſſolved in 3506 grains of water, making a brine of 4466 grains. A phial which held 1600 grains water held 1698 of this brine. It contained $\frac{1698 \times 960}{4466}$, or 365 grains of ſalt. The ſpecific gravity was $\frac{1698}{1600}$, = 1,061, and the cubic foot weighed 1061 ounces. It alſo contained $\frac{1061 \times 365}{1698}$, or 228 ounces of ſalt. By repeated abſtraction of brine, and replacing with water, we had the following ſeries:

Series.	Brine.	Sp. Gr.	Oz. Salt in Cub. F.
Weight of brine,	1*ſt*, 1698	1,061	228
After taking out $\frac{1}{4}$,	2*d*, 1676	1,048	171
After taking out $\frac{1}{3}$,	3*d*, 1653	1,033	114
After taking out $\frac{1}{2}$,	4*th*, 1630	1,019	57
After taking out $\frac{1}{2}$,	5*th*, 1616	1,010	$28\frac{1}{2}$
$\frac{1}{2}$,	6*th*, 1610	1,0063	$14\frac{1}{4}$
$\frac{1}{2}$,	7*th*, 1605	1,0038	$7\frac{1}{8}$

This ſeries is extremely regular, and the progreſs of denſity may be confidently deduced from it.

From the whole of this diſquiſition on the relation between the ſpecific gravities of brines and the quantities of ſalt contained, we ſee in general that it may be gueſſed at, with a uſeful degree of preciſion, from the denſity or ſpecific gravity of ſaturated ſolutions. We therefore conclude with a liſt of the ſpecific gravities of ſeveral ſaturated ſolutions, made with great care by the biſhop of Landaff.—The temperature was 42°. The firſt numerical column is the denſity of ſaturated brine, and the next is the denſity of a brine conſiſting of 12 parts (by weight) of water and one of ſalt. From this may be inferred the quantity in the ſaturated ſolution, and from this again may be inferred the quantity correſponding to inferior denſities.

Borax,	1,010	
Cor. Sublim.	1,037	
Alum,	1,033	
Glaub. Salt,	1,054	1,029
Common Salt,	1,198	1,059
Sal. cath. amar.	1,232	1,039
Sal ammon.	1,072	1,026
Vol. alk. mite,	1,087	
Nitre,	1,095	1,050
Rochelle ſalt,	1,114	
Blue vitriol,	1,150	1,052
Green vitriol,	1,157	1,043
White vitriol,	1,386	1,045
Pearl aſh,	1,534	

SPEC-

Spectacles || Spectre.

SPECTACLES, in dioptrics, a machine conſiſting of two lenſes ſet in ſilver, horn, &c. to aſſiſt the defects of the organ of ſight. Old people, and others who have flat eyes, uſe convex ſpectacles, which cauſe the rays of light converge ſo as to meet upon the retina: whereas myopes, or ſhort-ſighted people, uſe concave lenſes for ſpectacles, which cauſes the rays to diverge, and prevent their meeting ere they reach the retina. See OPTICS, nº 73.

OCULAR SPECTRA, images preſented to the eye after removing them from a bright object, or cloſing them. When any one has long and attentively looked at a bright object, as at the ſetting ſun, on cloſing his eyes, or removing them, an image, which reſembles in form the object he was attending to, continues ſome time to be viſible. This appearance in the eye we ſhall call the ocular ſpectrum of that object. *Phil. Tranſ.* 1786.

Theſe ocular ſpectra are of four kinds: 1ſt, Such as are owing to a leſs ſenſibility of a defined part of the retina or ſpectra from defect of ſenſibility. 2d, Such as are owing to a greater ſenſibility of a defined part of the retina, or ſpectra from exceſs of ſenſibility. 3d, Such as reſemble their object in its colour as well as form; which may be termed direct ocular ſpectra. 4th, Such as are of a colour contrary to that of their object, which may be termed reverſe ocular ſpectra.

SPECTRE, an apparition, ſomething made preternaturally viſible to human ſight, whether the ghoſts of dead men or beings ſuperior to man.

A belief that ſupernatural beings ſometimes make themſelves viſible, and that the dead ſometimes reviſit the living, has prevailed among moſt nations, eſpecially in the rudeſt ſtages of ſociety. It was common among the Jews, among the Greeks, and among the Romans, as we find from the Scriptures, and from the poems of Homer and Virgil. Celeſtial appearances were indeed ſo often exhibited to the Jews, that the origin of their belief is not difficult to be explained.—The Divine Being manifeſted himſelf to each of the Patriarchs by ſome ſenſible ſign, generally by a flame of fire, as he did to Moſes. Under this ſemblance alſo did he appear to the Iſraelites during their abode in the deſert, and after they obtained a ſettlement in the land of Canaan. Nor did they believe that heavenly beings alone aſſumed a ſenſible appearance: They believed that deceaſed men alſo ſometimes reviſited this world. When Saul went to conſult the witch at Endor, he aſked her to bring up the perſon whom he ſhould name unto her; a proof that he conſidered his demand as eaſy to be performed, and therefore that he probably acted under the influence of popular opinion. The ſame opinions had been generally entertained at a much earlier period; for necromancy and witchcraft, the arts by which the dead were ſuppoſed to be raiſed, had been prohibited while the Iſraelites were in the wilderneſs, and yet untainted with the vices of the Canaanites. They muſt therefore have derived them from Egypt, the cradle of ſuperſtition, as well as of the arts and ſciences.

Among the Greeks and Romans the apparition of ſpectres was generally believed. On innumerable occaſions the gods are ſaid to have diſcovered themſelves to the eyes of mortals, to have held conferences, and to have interpoſed their aid. The ghoſts of the dead, too, are ſaid to have appeared. When Æneas, amidſt the diſtraction and confuſion of his mind in flying from the deſtruction of Troy, had loſt his wife by the way, he returned in ſearch of her. Her ſhade appeared to him (for ſhe herſelf had been ſlain) with the ſame aſpect as before, but her figure was larger. She endeavoured to aſſuage the grief of her unhappy huſband, by aſcribing her death to the appointment of the gods, and by foretelling the illuſtrious honours which yet awaited him. But when Æneas attempted to claſp her in his arms, the phantom immediately vaniſhed into air. From this ſtory we may obſerve, that the ancients believed that the umbræ or ſhades, retained nearly the ſame appearance after death as before; that they had ſo far the reſemblance of a body as to be viſible; that they could think and ſpeak as formerly, but could not be touched. This deſcription applies equally well to thoſe ſhades which had paſſed the river Styx, and taken up their reſidence in the infernal regions. Such were the ſhades of Dido, of Deiphobus, and all thoſe which Æneas met with in his journey through the ſubterraneous world. Spectre.

It appears from the writings of modern travellers who have viſited rude and ſavage nations, that the belief of ſpectres is no leſs common among them. Mr Bruce tells us, that the prieſt of the Nile affirmed, that he had more than once ſeen the ſpirit of the river in the form of an old man with a white beard. Among the Mahometans the doctrine of ſpectres ſeems to be reduced to a regular ſyſtem, by the accounts which they give of genii. Whoever has read the Arabian Nights Entertainments muſt have furniſhed his memory with a thouſand inſtances of this kind. Their opinions concerning genii ſeem to be a corrupted mixture of the doctrines of the Jews and ancient Perſians. In Chriſtian countries, too, notwithſtanding the additional light which their religion has ſpread, and the great improvement in the ſciences to which it has been ſubſervient, the belief of ghoſts and apparitions is very general, eſpecially among the lower ranks. They believe that evil ſpirits ſometimes make their appearance in order to terrify wicked men, eſpecially thoſe who have committed murder.—They ſuppoſe that the ſpirits of dead men aſſume a corporeal appearance, hover about church yards and the houſes of the deceaſed, or haunt the places where murders have been committed. (See GHOST.) In ſome places it is believed that beings have been ſeen bearing a perfect reſemblance to men alive. In the Highlands of Scotland, what is called the ſecond ſight is ſtill believed by many (ſee *SECOND Sight*); viz. that future events are foretold by certain individuals by means of ſpectral repreſentation.

So general has the belief of ſpectres been, that this circumſtance alone may be thought by ſome ſufficient to prove that it muſt have its foundation in human nature, or muſt reſt upon rational evidence. When any doctrine has been univerſally received by all nations, by generations living ſeveral thouſand years from one another, and by people in all the different ſtages of ſociety, there is certainly the ſtrongeſt preſumption to conclude that ſuch a doctrine has its foundation in reaſon and in truth. In this way we argue in favour of the exiſtence of a God, concerning moral diſtinction, and the doctrine of a future ſtate: and certainly ſo far we argue well. But if the ſame argument be applied to idolatry, to ſacrifices, or to apparitions, we ſhall find that it is applied improperly. Idolatry was very general among ancient nations; ſo was the offering of ſacrifices,

Spectre. so was polytheiſm: but they were by no means univerſal. Should we allow, for the ſake of ſhortening the argument, that all ancient nations were polytheiſts and idolaters, and preſented oblations to their imaginary deities, all that could be concluded from this conceſſion is, that they fell into theſe miſtakes from their ignorance and from the rude ſtate of ſociety, from which their imperfect knowledge of theology and moral philoſophy was never able to reſcue them. Theſe erroneous notions fled before the brightneſs of the Chriſtian ſyſtem; while the doctrines of the exiſtence of God, of moral diſtinction, and of a future ſtate, have been more thoroughly confirmed and aſcertained. The ſame thing may be ſaid of the belief of ſpectres. However generally it has been adopted in the firſt ſtages of ſociety, or by civilized nations who had made but little progreſs in the ſtudy of divine things, it has been rejected, we may ſay invariably, wherever theology and philoſophy have gone hand in hand.

As all popular and long eſtabliſhed opinions are objects of curioſity and reſearch for the philoſopher, we think the belief of ſpectres worthy of ſome attention even in this light. It will therefore, we hope, give ſome ſatisfaction to the philoſophical reader to ſee a ſhort account of the ſources or principles from which this belief is derived. But as the belief of ſpectres is connected with other opinions which appear to us highly injurious to religion; opinions which have been ſupported by many learned men, and which are ſtill believed by ſome men of literary education—it will alſo be proper, in the firſt place, to conſider the evidence on which this belief reſts, in which we muſt conſider both their probability and credibility.

In the preſent inveſtigation we mean to ſet aſide altogether the celeſtial appearances recorded in Scripture, as being founded on unqueſtionable evidence, and perfectly agreeable to thoſe rules by which the Deity acts in the uſual courſe of his Providence. The Iſraelites, during the exiſtence of their ſtate, were immediately under the authority of God, not only as the moral governor of the world, but as the king of Iſrael. In the infancy of the world, while men were rude and unenlightened, and entirely under the influence of idolatry, many revelations were neceſſary to preſerve in their minds pure ideas of the nature of God, and of the worſhip due to Him. They were neceſſary alſo to pave the way for that illuſtrious diſpenſation which the Lord Jeſus came from Heaven to diffuſe over the world. Every celeſtial appearance recorded in Scripture was exhibited for ſome wiſe and important purpoſe, which muſt be apparent to every perſon who conſiders theſe appearances with attention. But when the Scriptures were written and publiſhed, and the Chriſtian religion fully eſtabliſhed, revelation ceaſed, and miracles and heavenly meſſages were no longer requiſite. What credit then ought we to give to thoſe marvellous ſtories related in ancient authors concerning prodigies in the heavens, and the apparition of angels both good and bad?

It is not pretended that any of thoſe prodigies and appearances were exhibited for purpoſes equally great and important with thoſe which are deſcribed in Scripture: And can we ſuppoſe that the all-wiſe Governor of the World would permit his angels to render themſelves viſible to the eye of man for no purpoſe at all, or for a purpoſe which might have been equally well accompliſhed without their interpoſition? Would this be conſiſtent with perfect wiſdom, or would it be conſiſtent even with the excellence and ſuperiority of underſtanding which we are taught to aſcribe to theſe elevated beings? The whole will of God is revealed to us in the Scriptures; what further uſe for the viſible interpoſition of angels? It may be objected, Are they not all miniſtering ſpirits ſent forth to miniſter for them who ſhall be heirs of ſalvation §? We anſwer, That angels may animate and ſupport good men by an inviſible interpoſition. But the Apoſtle is not ſpeaking of celeſtial ſpirits. The word αγγελος ſignifies "a meſſenger;" and in Scripture often refers to men. In the paſſage which we are now reviewing it certainly is applied with much more propriety to men than to angels: for the Apoſtle is ſtating a compariſon between *the Prophets*, by whom God, at ſundry times and in divers manners, ſpake in time paſt to the fathers, and *the Son*, by whom he hath ſpoken in theſe laſt days. Spectre. § Heb i. 14.

And if God has given no commiſſion to his angels to deliver to men ſince the publication of the Chriſtian religion, is there any probability that he would give any commiſſion or any licence to evil ſpirits? It will be ſaid, that this doctrine is clearly taught in the New Teſtament, in theſe words, "The devil goeth about as a roaring lion ſeeking whom he may devour." We will not avail ourſelves of the interpretation of ſome, who ſay that the word *devil*, which in the Greek language ſignifies an *adverſary*, or *ſlanderer*, refers here to ſome human being, who was a violent enemy of the Chriſtians. All that can be deduced from theſe words, upon the ſuppoſition that they refer to a malignant ſpirit, is merely that he goeth about ſeducing men to vice. But it is not by aſſuming a hideous form, and preſenting himſelf to the midnight traveller, that ſuch a purpoſe is to be accompliſhed. A ſpirit may probably have direct acceſs to our minds without the intervention of any thing corporeal; and by exciting our paſſions may plunge us into vice, which is the only object ſuch a being is ſuppoſed to have in view. None of the marvellous ſtories which we have heard concerning the apparition of evil ſpirits lead us to conclude that they appear to entice men to commit crimes. We never heard of any evil ſpirits that required men to ſteal, to perpetrate robbery or murder. They only appeared to terrify ſome crazy timorous individuals, who have whims and fancies enow of their own to agitate their minds, though no preternatural viſion ſhould ever appear to them. It is not conſiſtent, therefore, with the character of God, and what he has revealed to us of his will, to believe that he would commiſſion good angels, or permit evil angels, to appear to men ſince the propagation of the goſpel, or indeed at any former period of the world, unleſs ſome great and mighty purpoſe was to be fulfilled. It is not conſiſtent with what we know of the nature of good or bad angels to ſuppoſe, that though permiſſion were granted them occaſionally to ſhow themſelves to men, that they would appear in that way which ſtory-tellers deſcribe.

It is equally improbable that the ſpirits of the dead who have removed from this world ſhould again be permitted to viſit it. At death men undergo as great, perhaps a greater change, than when they came firſt into the light of the ſun. Is it not therefore as improbable that a man ſhould return in a viſible corporeal form

Spectre. form after death, as that, after having arrived at manhood, he ſhould return to the ſtate in which he was before his birth? Such changes as theſe are evidently made permanent by the invariable laws of nature. But ſuppoſe it were poſſible, for what purpoſe ſhould they return? To deſcribe to us what is paſſing in the other world, to animate us to virtue, by informing us of the rewards which there await the good; or to alarm us, by deſcribing the puniſhment of the wicked. Theſe ſeem important reaſons. But Divine Providence has wiſely thrown a veil over futurity. We know every thing of the other world from the ſcripture which it is proper for us at preſent to know. And as to incentives to virtue, we are already bleſſed with a number ſufficiently great and powerful for moral beings, who are to act from rational motives, and not from compulſion. "He that will not hear Moſes and the prophets, will not be perſuaded though one roſe from the dead."

Luke xvi. 31.

There is one ſtrong objection againſt the probability of ſpectres, which is ſufficient to prove that they are not intelligent creatures; or at leaſt that they poſſeſs ſo ſmall a degree of intelligence, that they are unqualified to act with prudence, to propoſe any end to themſelves, or uſe the proper means to accompliſh that end. Ghoſts often appear in order to diſcover ſome crime that has been committed: but they never appear to a magiſtrate, or perſon in authority, but to ſome illiterate clown, who happens to live near the place where the crime was perpetrated; to ſome perſon who has no connection with the affair at all, and who in general is the moſt improper in the world for making the diſcovery. For inſtance, in Glanville's *Saduciſmus triumphatus* (a book written in the laſt century by a chaplain of Charles II. in ſupport of the common opinions reſpecting witchcraft and apparitions), we have the following ſtory: James Haddock, a farmer, was married to Elenor Welſh, by whom he had a ſon. After the death of Haddock, his wife married one Davis; and both agreed to defraud the ſon by the former marriage of a leaſe bequeathed to him by his father. Upon this the ghoſt of Haddock appeared to one Francis Taverner the ſervant of lord Chicheſter, and deſired him to go to Elenor Welſh, and to inform her that it was the will of her former huſband that their ſon ſhould enjoy the leaſe. Taverner did not at firſt execute this commiſſion; but he was continually haunted by the apparition in the moſt hideous ſhapes, which even threatened to tear him in pieces, till at laſt he delivered the meſſage. Now, had this ſpectre had the leaſt common ſenſe, it would have appeared firſt to Elenor Welſh and her huſband Davis, and frightened them into compliance at once, and not have kept poor Taverner in ſuch conſtant diſquietude, who had no concern in the matter.

Another very odd circumſtance reſpecting apparitions in general muſt not be omitted, which is, that they have no power to ſpeak till they are addreſſed. In the 27th of Glanville's Relations we read of an old woman that appeared often to David Hunter, a neat-herd, at the houſe of the Biſhop of Down and Conners. Whenever ſhe appeared, he found himſelf obliged to follow her; and for three quarters of a year poor David ſpent the whole of almoſt every night in ſcampering up and down through the woods after this old woman. How long this extraordinary employment might have continued, it is impoſſible to gueſs, had not David's violent fatigue made him one night exclaim, "Lord bleſs me! would I were dead!—ſhall I never be delivered from this miſery!" On which the phantom replied, "Lord bleſs me too! It was happy you ſpoke firſt, for till then I had no power to ſpeak, though I have followed you ſo long." Then ſhe gave him a meſſage to her two ſons, though David told her he remembered nothing about her. David, it ſeems, neglected to deliver the meſſage; at which the old beldam was ſo much provoked, that ſhe returned and hit him a hearty blow on the ſhoulder, which made him cry out, and then ſpeak to her. Now if ſhe could not ſpeak till David addreſſed her, why might ſhe not have applied this oratorial medicine the firſt time ſhe appeared to him? It would have ſaved both herſelf and him many a weary journey; and certainly David would much rather have had even half a dozen of blows from her choppy fiſts than have wanted ſo many nights ſleep. To complete the ſtory, we muſt add, that when David's wife found it impoſſible to keep him from following the troubleſome viſitor, ſhe trudged after him, but never was gratified with a ſight of the enchantreſs. David's little dog too was a dutiful attendant on his maſter during his pilgrimage.

Spectre.

It is remarked by Glanville, that ghoſts are generally very eager to be gone. Indeed they are often ſo much ſo, that they do not ſtay to tell their errand. One would be induced from this, as well as the circumſtances already mentioned, to think that they are the ſtupideſt and dulleſt of the dead that aſſume the appearance of ghoſts; unleſs we adopt the ingenious ſolution of Glanville, "that it is a very hard and painful thing for them to force their thin and tenuious bodies into a viſible conſiſtence; that their bodies muſt needs be exceedingly compreſſed; and that therefore they muſt be in haſte to be delivered from the unnatural preſſure."

With reſpect to the *evidence* in favour of ſpectres, if examined ever ſo ſlightly, it will be found very defective. They only appear to one perſon at a time; they are ſeen only in the night; they are viſible only to ignorant, illiterate, and credulous perſons, and never preſent themſelves before men of education and learning.

That ſpectres only appear to one perſon at a time, even though there are more in company, is an objection againſt the credibility of their appearance quite inſurmountable. How is it poſſible that two men of eyeſight equally good, directing their eyes to the ſame ſpot, ſhould not ſee ſo large an object as that of a man or woman at a ſmall diſtance equally well? Some will tell us that a miſt is caſt over the eyes of the one, while the view of the other is free from obſtruction. But how is this to be proved? and beſides what purpoſe would it ſerve? Ghoſts have ſeldom any ſecrets to diſcloſe; they might be proclaimed to a multitude with as much propriety as confined to one perſon. Shall we be told, that the ſpectre has the power of becoming viſible to ſome, and of remaining inviſible to others? This cannot be allowed without adopting opinions deſtructive to revealed religion; for it would be a miracle: and we cannot be perſuaded, without evidence, that God would empower any inferior being to controul at pleaſure the wiſe laws which he has ordained for governing the world. To him who is of a different opinion, we would

Spectre.

would recommend Farmer on Miracles; a book in which this queſtion is fully examined.

Spectres appear only in the night. But why ſhould they ſhun the light of the ſun? Thoſe miſchievous ghoſts that Glanville mentions might indeed have ſome reaſon to chooſe midnight for the execution of their pranks, as they would be more eaſily detected in open day. Such was the roguiſh drummer that haunted Mr Mompeſſon's houſe, who beat his drum all night, threw the old gentlewoman's clothes about the room, hid her Bible in the aſhes, plucked the clothes off the bed, and amuſed himſelf with toſſing about Mr Mompeſſon's ſhoes. But why ſhould a grave ſerious ghoſt appear at midnight? Might it not deliver its meſſage with as much eaſe and more ſucceſs in the day-time? In the day-time it would not excite much fear; it would be liſtened to therefore with more attention; and did it chooſe to exhibit itſelf before a number of witneſſes, its grievances would be more ſpeedily redreſſed, becauſe more perſons would intereſt themſelves in ſeeing juſtice done to the injured ghoſt.

Spectres not only chooſe the moſt improper time, but the moſt improper perſons. To render the teſtimony of any perſon credible, he muſt not only be a man of veracity, but he muſt have ſufficient ability to judge of the ſubject to which he is to bear witneſs. It is not on the evidence of an ignorant illiterate perſon, who has more fancy and fear than judgment, that we are to reſt our belief of what is ſupernatural. It is alſo worthy of remark, that we have never heard of a ghoſt appearing to any perſon who did not previouſly believe their exiſtence. A man muſt be prejudiced in favour of this opinion, or he will never ſee a ghoſt. But ſenſible men know, that he who has been accuſtomed to hear frightful ſtories of ghoſts and apparitions gliding thro' a church-yard, or haunting ſome particular place, can ſcarcely paſs through a church-yard or haunted ſpot without conjuring up in his imagination the hideous phantoms which he has been accuſtomed to aſſociate with ſuch places. Is it ſtrange, then, that an ignorant man, with a mind uncultivated and uninformed, with all the prejudices of the nurſery about him, ſhould imagine he ſees ghoſts in thoſe places where he believes they hover, eſpecially in the dead hour of midnight, when, with the ſlighteſt aid of the imagination, a cow may be turned into a monſtrous phantom, and the reflection of the beams of the moon from a little water be converted into a ghoſt with a winding-ſheet? But why ſhould apparitions ſhun men of underſtanding and learning? Why ſhould learning be formidable to them (A)? It was not ſo with the celeſtial meſſengers mentioned in the Scriptures: they appeared to the patriarchs and prophets; and the miracles there recorded were performed in the moſt public places, before the eyes of Rabbies, of Scribes, and Phariſees. Indeed this circumſtance is ſufficient to deſtroy the evidence of ſpectres. They have never been ſeen by any but men of weak or diſtempered minds, or by men who have previouſly believed in them. Spectre.

Having now conſidered the evidence on which the belief of ſpectres reſts, we will endeavour to give ſome account of the foundation of it. To trace an opinion that has prevailed ſo generally in the world to its ſource, is a labour not unworthy of the philoſopher, even tho' the opinion be falſe. It is always gratifying to detect the cauſes of error: it is no leſs uſeful; for in order to refute error, it is often ſufficient to point out the ſources from which it has ſprung. To reach the origin of the belief of ſpectres is not more difficult than to account for idolatry or polytheiſm. In the infant ſtate of the intellectual powers every thing is conſidered as poſſeſſing life and intelligence. The child beats the ſtool over which he has fallen with the ſame paſſion that he would treat his companion: The young girl talks to her doll as if it underſtood her: The ſavages aſcribe every change which they obſerve on the face of nature to the action of ſome animated being. As knowledge advances, they ſingle out thoſe beings which ſeem to produce the moſt ſtriking effects, arrange them into ſome kind of order, and divide the government of the world among them. Unable, at the ſame time, to conceive any notion of a pure ſpirit, they imagine thoſe divinities are corporeal beings. This is the foundation of idolatry. The belief of ſpectres is but another ſtep. That theſe animated corporeal beings, to whom they addreſs their prayers, and who preſide over the world, ſhould on particular occaſions diſplay themſelves to the human eye, is what they muſt be previouſly diſpoſed to expect. Hence the numberleſs appearances of the heathen gods, of the Perſian and Mahometan genii. The belief

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(A) The celebrated hiſtorian De Thou had a very ſingular adventure at Saumur, in the year 1598. One night, having retired to reſt very much fatigued, while he was enjoying a ſound ſleep, he felt a very extraordinary weight upon his feet, which, having made him turn ſuddenly, fell down and awakened him. At firſt he imagined that it had been only a dream, but hearing ſoon after ſome noiſe in his chamber, he drew aſide the curtains, and ſaw, by help of the moon, which at that time ſhone very bright, a large white figure walking up and down, and at the ſame time obſerved upon a chair ſome rags, which he thought belonged to thieves who had come to rob him. The figure then approaching his bed, he had the courage to aſk it what it was. "I am (ſaid it) the Queen of Heaven." Had ſuch a figure appeared to any credulous ignorant man in the dead of night, and made ſuch a ſpeech, would he not have trembled with fear, and have frightened the whole neighbourhood with a marvellous deſcription of it? But De Thou had too much underſtanding to be ſo impoſed upon. Upon hearing the words which dropped from the figure, he immediately concluded that it was ſome mad woman, got up, called his ſervants, and ordered them to turn her out of doors; after which he returned to bed and fell aſleep. Next morning he found that he had not been deceived in his conjecture, and that having forgot to ſhut his door, this female figure had eſcaped from her keepers, and entered his apartment. The brave Schomberg, to whom De Thou related his adventure ſome days after, confeſſed that in ſuch a caſe he would not have ſhown ſo much courage. The king alſo, who was informed of it by Schomberg, made the ſame acknowledgement.

Sphacelus || Sphere.

whom Mr Pennant had the account, and who was six feet four inches high, up to the breaſt. The banks are here very high and ſteep; ſo that had not the rebels been infatuated in ſuch a manner as to neglect oppoſition, the paſſage muſt have been attended with conſiderable loſs. On this river there is a great ſalmon-fiſhery; about 1700 barrels full are caught in the ſeaſon, and the ſhore is rented for about 1200l. *per annum*.

SPHACELUS, in ſurgery and medicine, an abſolute and perfect corruption or death of the parts.

SPHÆRANTHUS, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and to the order of *polygamia ſegregata*; and in the natural ſyſtem arranged under the 49th order, *Compoſitæ*. Each partial calyx contains eight florets; the florets are tubulated, the female being ſcarcely diſtinguiſhable. The receptacle is ſcaly; and there is no pappus. The ſpecies are three, the indicus, africanus, and chinenſis.

SPHAGNUM, BOG-MOSS, in botany; a genus of plants belonging to the claſs of *cryptogamia* and order of *muſci*. The antheræ are globoſe; the mouth entire and cloſed by an operculum; the calyptra is wanting. There are three ſpecies, the paluſtre, alpinum, and arboreum, 1. The *paluſtre*, common bog-moſs, grows on our bogs in wide patches, ſo as frequently to cover a large portion of their ſurface. The ſtalks are from two inches to two feet long, irregularly ſurrounded with numerous, conical, pendant branches, and terminated with a roſaceous cluſter of erect ſhort ones. It is generally believed, that the roots and decayed ſtalks of this moſs conſtitute a principal part of that uſeful bituminous ſubſtance called *peat*, which is the chief fuel of the northern regions.—The Lapland matrons are well acquainted with this moſs. They dry and lay it in their cradle, to ſupply the place of bed, bolſter, and every covering; and, being changed night and morning, it keeps the infant remarkably clean, dry, and warm. It is ſufficiently ſoft of itſelf; but the tender mother, not ſatisfied with this, frequently covers the moſs with the downy hairs of the rein-deer; and by that means makes a moſt delicate neſt for the young babe. 2. The *alpinum*, green bog-moſs. Its branches are ſubulate and erect; the antheræ are oval. It grows in mountain bogs in South Britain. 3. The *arboreum*, creeping bog-moſs, is branched; the antheræ are numerous, ſeſſile, hairy, and grow along the branches chiefly on one ſide. It is found on the trunks of trees.

Os SPHENOIDES, the ſeventh bone of the cranium or ſkull. See ANATOMY, n° 11.

SPHERE, is a ſolid contained under one uniform round ſurface, every point of which is equally diſtant from a certain point in the middle called its *centre*; and is formed by the revolution of a ſemicircle about its diameter. See GEOMETRY.

Projection of the SPHERE. See PROJECTION.

SPHERE, in aſtronomy, that concave orb or expanſe which inveſts our globe, and in which the heavenly bodies appear to be fixed, and at an equal diſtance from the eye.

The better to determine the places of the heavenly bodies in the ſphere, ſeveral circles are ſuppoſed to be deſcribed on the ſurface thereof, hence called the *circles of the ſphere*: of theſe ſome are called *great circles*, as the equinoctial, ecliptic, meridian, &c. and others *ſmall circles*, as the tropics, parallels, &c. See GEOGRAPHY; and ASTRONOMY, *paſſim*.

Sphere || Sphinx.

Armillary SPHERE. See GEOGRAPHY.

SPHERE of Activity of a Body, is that determinate ſpace or extent to which, and no farther, the effluvia continually emitted from that body reach; and where they operate according to their nature.

SPHERES, in optics, the ſame with metalline mirrors, for teleſcopes or other purpoſes. See MIRROR.

SPHEROID, in geometry, a ſolid approaching to the figure of a ſphere. It is generated by the entire revolution of a ſemi-ellipſis about its axis. When the revolution is made round the largeſt axis, the ſpheroid is called *prolate*; and when round the ſhorteſt, *oblate*. This laſt is the figure of the earth, and probably of all the planets.

SPHEX, ICHNEUMON WASP, or *Savage*; a genus of inſects belonging to the order of *hymenopteræ*. The mouth is armed with entire jaws, but contains no tongue; the mandibles are horny, crooked, dentated; the lip horny, the apex membranaceous. The palpi or feelers are four. The antennæ have from 10 to 16 joints. The wings of both ſexes are extended without folds, and laid horizontally on the back. The ſting is ſharp, and concealed within the abdomen. There are 97 ſpecies, of which two only are natives of Britain and Ireland, the viatica and cribraria. 1. The *viatica* is black: the antennæ are ſhort and thick: the three firſt ſegments of the abdomen red-brown: the pedicle is ſhort: the length half an inch. 2. The *cribraria* is black, with yellow ringlets on the abdomen: the antennæ are ſhort, and turned backwards: the fore-legs are broad, with an appendix like a ſhield.

The manner of living is different in the various ſpecies, and ſo is the general form of the body and their haunts; but though the method of life be utterly different, yet the ſame manners appear innate and inherent in all. They agree in being the fierceſt of all flies: they will attack inſects much larger than themſelves, and this whether they be defenceleſs or armed, as they are provided with a ſting. The ſtrength in all this ſavage kind is great; their jaws are hard and ſharp, and in their ſting lies a poiſon ſuddenly fatal to the creatures with whom they engage. The ſavage ſeizes hardily on the animal he attacks, and gives a ſtroke of amazing force; after which he falls down as if himſelf were killed, but it is to reſt from his fatigue, and enjoy his victory. He keeps a ſteady eye on the creature he has ſtruck till it dies, which happens in a few minutes, and then drags it to the neſt to feed the young. The number of other inſects they deſtroy is ſcarce to be conceived; the mouth of their cave is like that of a giant in the days of yore, ſtrewed with the remains of prey. The eyes, the filament that ſerves as a brain, and a ſmall part of the contents of the body, are all the ſavage eats, and will kill 50 for a meal.

SPHINCTER, in anatomy, a term applied to a kind of circular muſcles, or muſcles in form of rings, which ſerve to cloſe and draw up ſeveral orifices of the body, and prevent the excretion of the contents.

SPHINX (fab. hiſt.), a monſter which had the head and breaſts of a woman, the body of a dog, the tail of a ſerpent, the wings of a bird, the paws of a lion, and an human voice. It ſprang from the union of Orthos

Sphinx. with the Chimæra, or of Typhon with Echidna. The Sphinx had been ſent into the neighbourhood of Thebes by Juno, who wiſhed to puniſh the family of Cadmus, which ſhe perſecuted with immortal hatred, and it laid this part of Bœotia under continual alarms, by propoſing enigmas, and devouring the inhabitants if unable to explain them. In the midſt of their conſternation the Thebans were told by the oracle, that the ſphinx would deſtroy herſelf as ſoon as one of the enigmas ſhe propoſed was explained. In this enigma ſhe wiſhed to know what animal walked on four legs in the morning, two at noon, and three in the evening. Upon this Creon king of Thebes promiſed his crown and his ſiſter Jocaſta in marriage to him who could deliver his country from the monſter by a ſucceſsful explanation of the enigma. It was at laſt happily explained by Œdipus, who obſerved, that man walked on his hands and feet when young, or in the morning of life, at the noon of life he walked erect, and in the evening of his days he ſupported his infirmities upon a ſtick. (*Vid. Oedipus*). The ſphinx no ſooner heard this explanation than ſhe daſhed her head againſt a rock, and immediately expired. Some mythologiſts wiſh to unriddle the fabulous traditions about the ſphinx by the ſuppoſition that one of the daughters of Cadmus, or Laius, infeſted the country of Thebes by her continual depredations, becauſe ſhe had been refuſed a part of her father's poſſeſſions. The lion's paw expreſſed, as they obſerve, her cruelty, the body of the dog her laſciviouſneſs, her enigmas the ſnares ſhe laid for ſtrangers and travellers, and her wings the diſpatch ſhe uſed in her expeditions.

Lempriere's Bibliotheca Claſſica.

Among the Egyptians the ſphinx was the ſymbol of religion, by reaſon of the obſcurity of its myſteries; and on the ſame account the Romans placed a ſphinx in the pronaos or porch of their temples. Sphinxes were uſed by the Egyptians to ſhow the beginning of the water's riſing in the Nile: with this view, as it had the head of a woman and body of a lion, it ſignified that the Nile began to ſwell in the months of July and Auguſt, when the ſun paſſes through the ſigns of Leo and Virgo. There are ſeveral of theſe ſtill to be ſeen; one in particular, near the pyramids, much ſpoken of by the ancients; being of a prodigious ſize, and cut out of the rock; the head and neck appear only at preſent, the reſt of the body being hid in the ſand. This, according to Thevenot, is 26 feet high, and 15 feet from the ear to the chin: but Pliny aſſures us, the head was no leſs than 102 feet in circumference, and 62 feet high from the belly, and that the body was 143 feet long, and was thought to be the ſepulchre of king Amaſis.

* *Ancient Mythology*, vol. iii. p. 532.

The learned Mr Bryant * obſerves, that the ſphinx ſeems to have been originally a vaſt rock of different ſtrata; which, from a ſhapeleſs maſs, the Egyptians faſhioned into an object of beauty and veneration. The Egyptians uſed this figure in their building; from them the Greeks derived it, and afterwards improved it into an elegant ornament. It is alſo frequently uſed in modern architecture.

‡ Vol. ii. p. 334.

It is proper to obſerve, that the ſphinx of the Egyptians is ſaid in the Aſiatic Reſearches ‡ to have been found in India. Colonel Pearſe was told by Murari Pandit, a man of learning among the Hindoos, that the ſphinx there called *ſingh* is to appear at the end of the world, and as ſoon as he is born will prey on an elephant: he is therefore figured ſeizing an elephant in his claws; and the elephant is made ſmall, to ſhow that the *ſingh*, even a moment after his birth, will be very large in proportion to it. But in oppoſition to this account given by Murari Pandit, the late Sir William Jones, the learned and illuſtrious preſident of the Aſiatic Society, was aſſured by ſeveral Brahmans, that the figure taken for a ſphinx was a repreſentation of a lion ſeizing a young elephant. This point therefore requires farther inveſtigation. Sphinx.

Sphinx, *Hawk-Moth*, in natural hiſtory; a genus of inſects belonging to the order of *lepidoptera*. The antennæ are ſhaped ſomewhat like a priſm, and are more ſlender at each end than at the middle. The tongue is generally thruſt out: the two palpi are bent back, and the wings deflexed. There are about 165 ſpecies already diſcovered, of which 10 are found in Great Britain and Ireland.

1. The *ocellata*, eyed willow hawk-moth. There is no trunk; the wings are indented. Above, 1ſt wings dark and light-brown, marbled; 2d, red, with a large yellow-black eye. Beneath, a large red triangle from the baſe of the 1ſt wings. The breadth one inch and an half. Caterpillar ſmooth, green, with oblique white lines on the ſides, and a poſterior horn. The eggs are green. It lives on willows. 2. *Populi*, poplar hawk-moth. The wings are ſcalloped, bluiſh grey, and waved with dark lines. On the 1ſt wings a long white ſpot, and the baſe of the 2d red-brown. Wings reverſed. Length one inch. A long ſpiral trunk caterpillar green, ſmooth, with oblique white ſpots, and a poſterior horn. It lives on poplars and willows. 3. *Tiliæ*, lime hawk-moth. No trunk: the wings are ſcalloped: the antennæ are white on the upper ſide, yellow on the under. Above, 1ſt wings grey-brown, with two irregular large green ſpots; 2d, wings orange. Beneath greeniſh grey. Caterpillar green, ſhagreened, with a poſterior horn. 4. *Convolvuli*, unicorn, or bindweed hawk-moth. The antennæ are long and thick: the trunk very long and ſpiral. Above, body marked with black and red belts; wings entire, brown-grey, with black zig-zag tranſverſe lines. The breadth three inches. Caterpillar ſmooth, green, with a poſterior horn. 5. *Liguſtri*, privet hawk-moth. The antennæ are long, thick, and brown. Trunk long, ſpiral. 1ſt wings two inches long, narrow, entire, brown; 2d, ſhort, red, with black bars. The abdomen is red, with black rings. Caterpillar ſmooth, yellow-green, with a poſterior horn. 6. *Atropos*, jeſſamine hawk-moth. The wings are entire: the trunk long, ſpiral. Above, 1ſt wings brown, clouded with grey and yellow, and a yellowiſh ſpot in the centre; 2d, yellow, with two waved tranſverſe ſtripes. The abdomen is yellow, with ſeven black-brown belts. The thorax marked like a Death's-head. Length two inches. Caterpillar very large, yellow, with ſix green and orange oblique belts, and a poſterior horn. 7. *Elpenor*, elephant moth. The wings are angular, entire. Above, 1ſt wings ſtriped tranſverſely with red and green; 2d, black at the baſe, and red outwards. The body red and green. Caterpillar ſmooth, brown and yellow, with a poſterior horn, and a ſnout like a hog. It lives on vines, convolvulus, &c. 8. *Stellatarum*, large bee moth. The antennæ are thick towards the ends,

Sphinx, Spigelia.

brown. The trunk is ſpiral: the wings are ſhort and entire: the body is thick, brown, and hairy. Firſt wings are brown, waved; 2d, red-brown. It reſembles a large bee. Caterpillar ſmooth, with a poſterior blue horn, tipt with red. It lives on gallium. 9. *Tipuliformis*, ſmall bee moth. The thorax is yellow beneath: the wings are ſhort, with black veins. The abdomen black, bearded, yellow at the extremity. Caterpillar on the lonicera. 10. *Filipendulæ*, burnet moth. The antennæ, legs, and body, are black. Second wings red, with a greeniſh border. Firſt wings bluiſh green, with ſix red ſpots, in pairs. Length eight lines. Caterpillar yellow, with black ſpots. It lives on graſs.

The name *ſphinx* is given to this genus on account of the ſingular attitudes of their caterpillars, who apply the hinder part of their body to a branch of a tree, holding the reſt of it erect, like the fabulous ſphinx. Moſt of them ſpin their cod under ground, making them up with ſmall parcels of earth and grains of corn interwoven with threads. The ſphinges fly either early in the morning, or after ſunſet in the evening. They fly heavily and ſluggiſhly, often emitting a kind of ſound.

SPIGELIA, Worm-grass, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *monogynia*; and in the natural ſyſtem arranged under the 47th order, *Stellatæ*. The corolla is funnel-ſhaped; the capſule is didymous, bilocular, and polyſpermous. There are two ſpecies, the anthelmia and marilandica.

The *anthelmia* has a herbaceous ſtem, and its higheſt leaves are fourfold.

"The effects of this medicine (ſays Dr Browne) are theſe: It firſt procures ſleep, almoſt as certainly, and in an equal degree, with opium; the eyes ſeem to be diſtended, and ſparkle as it were before the eruption of the ſmall-pox or meaſles, which may be eaſily obſerved after the ſleep is over; the pulſe grows regular and riſes, the fever cools, the ſymptoms appear more favourable, and the worms are generally diſcharged by the uſe of the ſubſequent purgatives (if not before) in great quantities, often above 100 at a time; but when a few only come away, which is ſeldom, and theſe alive, the ſame doſes are again repeated, which ſeldom or never fail. I never ſaw this medicine fail when there was the leaſt probability of ſucceſs; nay, often prove ſucceſsful when there was not the leaſt reaſon to expect it. I have been, however, cautious in ordering it for children; for though I never knew it at all hurtful, its effect upon the eyes has often deterred me from ordering it to children, whoſe fibres are weak and relaxed, and in whom the fevers from this ſource are ſeldom ſo vehement as to hinder the adminiſtration of other medicines, likely as effectual in other caſes of this nature. This plant is generally had in low dry lands, after they have been turned up ſome months, and after great rains; its taſte is herbaceous, and ſomewhat clammy, its growth is ſoft and ſudden, its ſtalk hollow, ſmooth, and roundiſh. Its herbaceous taſte and ſudden growth would alone make me think it capable of little or no action, had not hundreds of careful obſervations ſatisfied me to the contrary."

The *marilandica*, perennial worm-graſs, or Indian pink. The beſt deſcription of this plant which we have ſeen is given by Dr Woodville, in his Medical Botany; a work which exhibits a complete ſyſtematic view of the medicinal effects of vegetables. Its ſtem is four-cornered; all the leaves oppoſite. Spigelia, Spice.

Dr Garden, in a letter to the late Dr Hope, profeſſor of botany in the univerſity of Edinburgh, dated 1763, gives the following account of the virtues of this plant. "About 40 years ago, the anthelmintic virtues of the root of this plant were diſcovered by the Indians; ſince which time it has been much uſed here by phyſicians, practitioners, and planters; yet its true doſe is not generally aſcertained. I have given it in hundreds of caſes, and have been very attentive to its effects. I never found it do much ſervice, except when it proved gently purgative. Its purgative quality naturally led me to give it in febrile diſeaſes, which ſeemed to ariſe from viſcidity in the *primæ viæ*; and, in theſe caſes, it ſucceeded to admiration, even when the ſick did not void worms.

"I have of late, previous to the uſe of the Indian pink, given a vomit, when the circumſtances of the caſe permitted it; and I have found this method anſwer ſo well, that I think a vomit ſhould never be omitted. I have known half a dram of this root purge as briſkly as the ſame quantity of rhubarb; at other times I have known it, though given in large quantities, produce no effect upon the belly: in ſuch caſes, it becomes neceſſary to add a grain or two of ſweet mercury, or ſome grains of rhubarb; but it is to be obſerved, that the ſame happy effects did not follow its uſe in this way, as when it was purgative without addition. The addition, however, of the purgative renders its uſe ſafe, and removes all danger of convulſions of the eyes, although neither *ol. rutæ*, *ſabinæ*, or any other nervous ſubſtance, is given along with it. It is, in general, ſafer to give it in large doſes than in ſmall; for, from the latter, more frequently the giddineſs, dimneſs of the ſight, and convulſions, &c. follow; whereas, from large doſes, I have not known any other effect than its proving emetic or violently cathartic. To a child of two years of age, who had been taking 10 grains of the root twice a-day, without having any other effect than making her dull and giddy, I preſcribed 22 grains morning and evening, which purged her briſkly, and brought away five large worms. After ſome months an increaſed doſe had the ſame good effects. I prefer the root to the other parts of the plant; of which, when properly dried, I gave from 12 to 60 or 70 grains in ſubſtance. In infuſion, it may be given to the quantity of two, three, or four drams, twice a-day. I have found that, by keeping, the plant loſes its virtue in part; for 40 grains of the root which has not been gathered above two months, will operate as ſtrongly as 60 which has been kept for 15 months."

In Dr Garden's ſubſequent letters, addreſſed to Dr Hope, in the years 1764 and 1766, the efficacy of this root in worm caſes is further confirmed; and he obſerves, that the root keeps better than he at firſt thought (having lately uſed it ſeveral years old with great ſucceſs). In what he calls continued or remitting low worm fevers, he found its efficacy promoted by the addition of *rad. ſepentar virg.*

SPICE, any kind of aromatic drug that has hot and pungent qualities: ſuch are pepper, nutmeg, ginger, cinnamon, cloves, &c.

Spice || Spinal

Spice-Islands, in the East Indies. See Banda, *Moluccа-Islands*, and Ceylon.

SPIDER, in zoology. See Aranea.

SPIDERWORT, in botany. See Phalangium.

SPIGNEL, in botany. See Athamanta.

SPIKE, or *Oil of Spike*, a name given to an eſſential oil diſtilled from lavender, and much uſed by the varniſh-makers and the painters in enamel.

SPIKENARD, in botany. See Nardus.

SPILANTHUS, in botany; a genus of plants belonging to the claſs of *ſyngeneſia*, and to the order of *polygamia æqualis*. The common calyx is erect; the leaflets numerous, ſub-equal, and oblong, the two exterior being longer than the reſt. The compound corolla is uniform and tubular; the florets are hermaphrodite and equal; the proper corolla is funnel-ſhaped. The filaments are five in number, and ſhort. The antheræ cylindrical and tubular. The ſeeds are vertical, oblong, flat, and covered with chaff. The receptacle is paleaceous and conical. There are ſeven ſpecies, the urens, pſeudo-acmella, acmella, ſalivaria, atriplicifolia, inſipida, and oleracea.

SPINA cervina, the ſame as the rhamnus catharticus. See Rhamnus.

Spina Ventoſa, in ſurgery, that ſpecies of corruption of the bones which takes its riſe in the internal parts, and by degrees enlarges the bone, and raiſes it into a tumor. See Surgery.

SPINACIA, spinage, in botany: A genus of plants belonging to the claſs of *diœcia*, and to the order of *pentandria*; and in the natural ſyſtem arranged under the 12th order, *Holoraceæ*. The male calyx is quinquepartite; there is no corolla: the female calyx is quadrifid; no corolla; there are four ſtyles, and one ſeed within the indurated calyx. There are only two ſpecies, the oleracea and fera. 1. The *oleracea*, common ſpinage, has ſeſſile fruits and ſagittated leaves. It has been cultivated in Britain ſince 1568, but it is not known from what country it was originally brought. When intended for winter uſe, it ſhould be ſown on an open ſpot of ground in the latter end of July; obſerving to do it if poſſible when the weather is rainy. When the young plants are come up, the weeds muſt be deſtroyed, and the plants left at about five inches aſunder. The ground being kept clear of weeds, the ſpinage will be fit for uſe in October. The way of gathering it to advantage is only to take off the longeſt leaves, leaving thoſe in the centre to grow bigger; and at this rate a bed of ſpinage will furniſh the table for a whole winter, till the ſpinage ſown in ſpring is become fit for uſe, which is common in April. 2. The *fera*, wild ſpinage, produces its fruit on footſtalks.

SPINAGE, or Spinach. See Spinacia.

SPINÆ, in botany, thorns, rigid prickles: a ſpecies of *arma*, growing on various parts of certain plants for their defence; *ſpinæ ramorum arcent pecora*. On the branches we find examples in the pyrus, prunus, citrus, hippophaes, gmelina, rhamnus, lycium, &c.; on the leaves in the aloe, agave, yucca, ilex, hippomane, theophraſta, carlina, &c.; on the calyx, in the carduus, cnicus, centauria, moluccella, galeopſis, &c.; on the fruit, in the trapa, tribulus, murex, ſpinacia, agremonia, datura, &c.

SPINAL marrow. See Anatomy, Part V. n° 132.

SPINALIS, in anatomy, the name of ſeveral muſcles, &c. of the ſpine. Spinalis || Spinning.

SPINDLE-tree, in botany. See Euonymus.

SPINE, spina dorsi. See Anatomy, n° 30.

Spine, in botany. See Spinæ.

SPINELLO, a Tuſcan painter, of great repute in his time. He painted a picture of the fallen angels, in which he drew ſo horrid a picture of Lucifer, that it frightened him ſo much as to affect his ſenſes ever after. He flouriſhed about the year 1380.

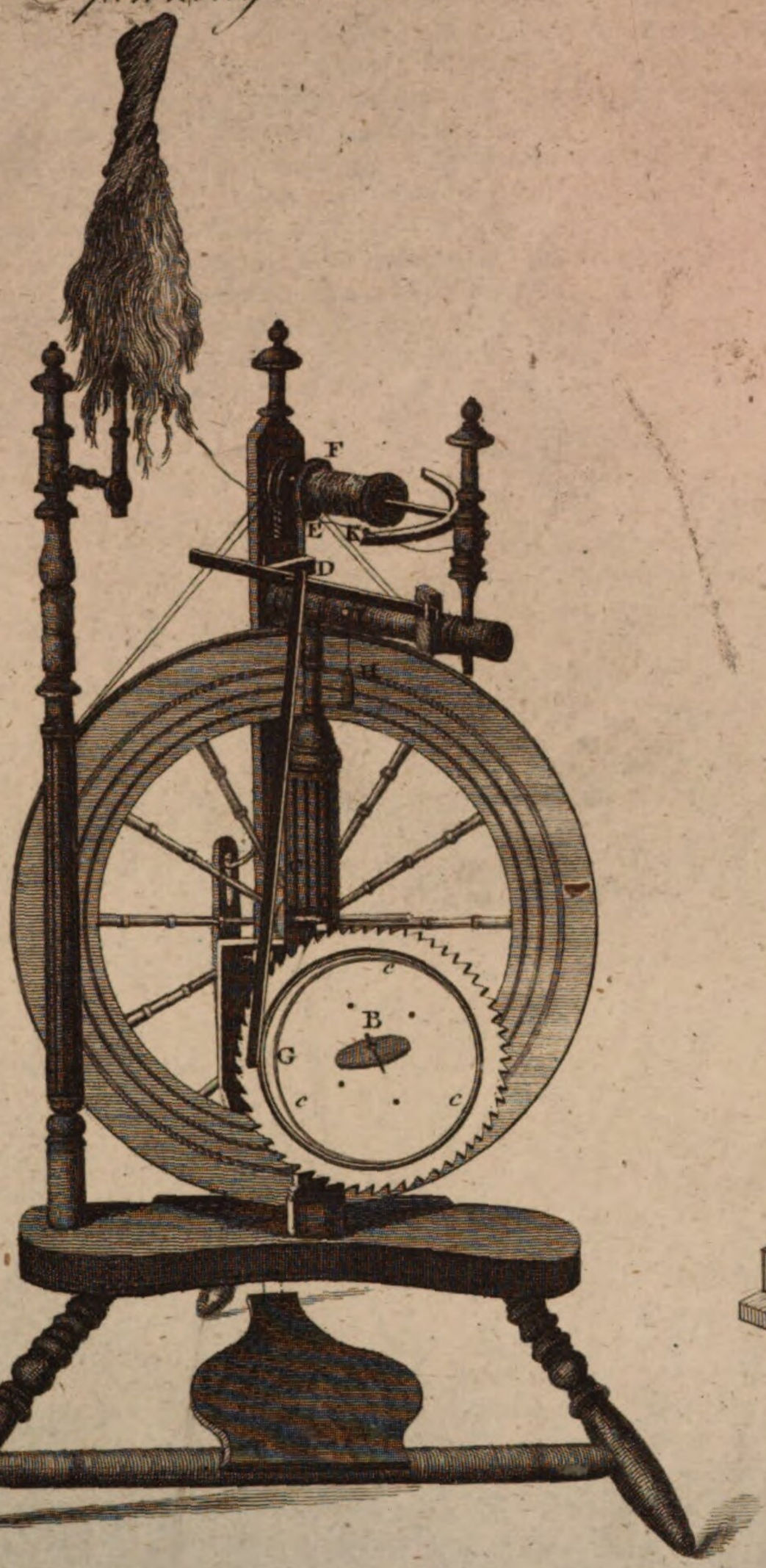
SPINET, or Spinnet, a muſical inſtrument ranked in the ſecond or third place among harmonious inſtruments. It conſiſts of a cheſt or belly made of the moſt porous and reſinous wood to be found, and a table of fir glued on ſlips of wood called *ſummers*, which bear on the ſides. On the table is raiſed two little prominences or bridges, wherein are placed ſo many pins as there are chords or ſtrings to the inſtrument. It is played on by two ranges of continued keys, the former range being the order of the diatonic ſcale, and that behind the order of the artificial notes or ſemitones. The keys are ſo many flat pieces of wood, which, touched and preſſed down at the end, make the other raiſe a jack which ſtrike and ſound the ſtrings by means of the end of a crow's quill, wherewith it is armed. The 30 firſt ſtrings are of braſs, the other more delicate ones of ſteel or iron-wire; they are all ſtretched over the two bridges already mentioned. The figure of the ſpinet is a long ſquare or parallelogram; ſome call it an *harp couched*, and the harp an *inverted ſpinet*. See the article Harp.

This inſtrument is generally tuned by the ear, which method of the practical muſicians is founded on a ſuppoſition that the ear is a perfect judge of an octave and a fifth. The general rule is to begin at a certain note, as C, taken towards the middle of the inſtrument, and tuning all the octaves up and down, and alſo the fifths, reckoning ſeven ſemitones to each fifth, by which means the whole is tuned. Sometimes to the common or fundamental play of the ſpinet is added another ſimilar one in uniſon, and a third in octave to the firſt, to make the harmony the fuller; they are either played ſeparately or together by means of a ſtop: theſe are called *double* or *triple ſpinets*; ſometimes a play of violins is added, by means of a bow, or a few wheels parallel to the keys, which preſs the ſtrings and make the ſound laſt as long as the muſician pleaſes, and heighten and ſoften them more or leſs, as they are more or leſs preſſed. The harpſichord is a kind of ſpinet, only with another diſpoſition of the keys (ſee the article Harpsichord). The inſtrument takes its name from the ſmall quill ends which touch the ſtrings, reſembling *ſpinæ* or thorns.

SPINIFEX, in botany; a genus of plants belonging to the glaſs of *polygamia* and order of *monœcia*. The hermaphrodite flowers have a calyx with bivalved biflorous glumes, the valvelets being parallel to the rachis; the corolla is bivalved and awnleſs; there are three ſtamina and two ſtyles. In the male flowers the calyx is common with the hermaphrodite; the corolla and ſtamina are ſimilar. There is only one ſpecies, the ſquarroſus.

SPINNING, in commerce, the act or art of reducing ſilk, flax, hemp, wool, hair, or other matters, into thread. Spinning is either performed on the wheel, or with a diſtaff and ſpindle, or with other machines proper

Mr Antis's improved Spinning Wheel.



Stove.

Fig. 1.

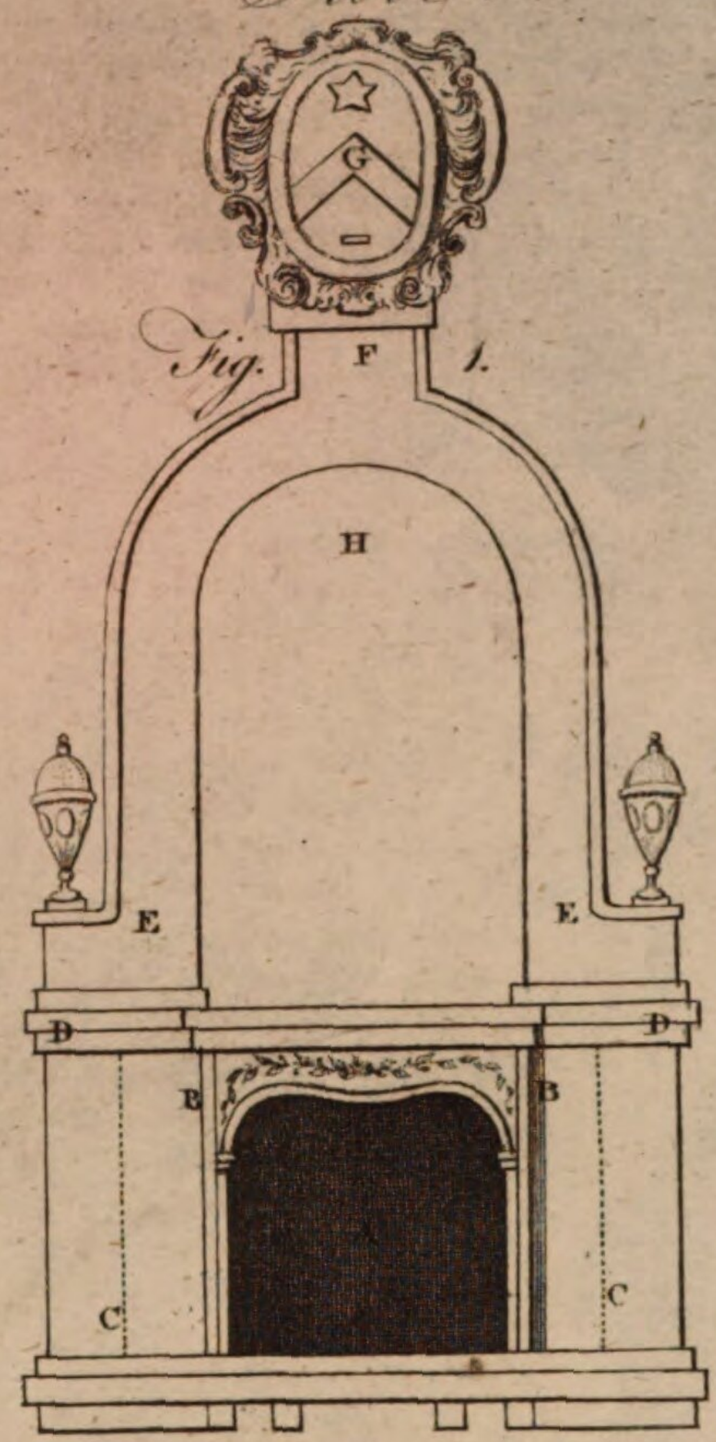
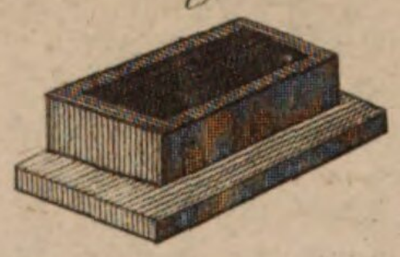


Fig. 2.



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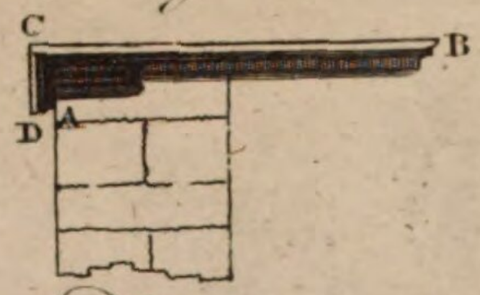
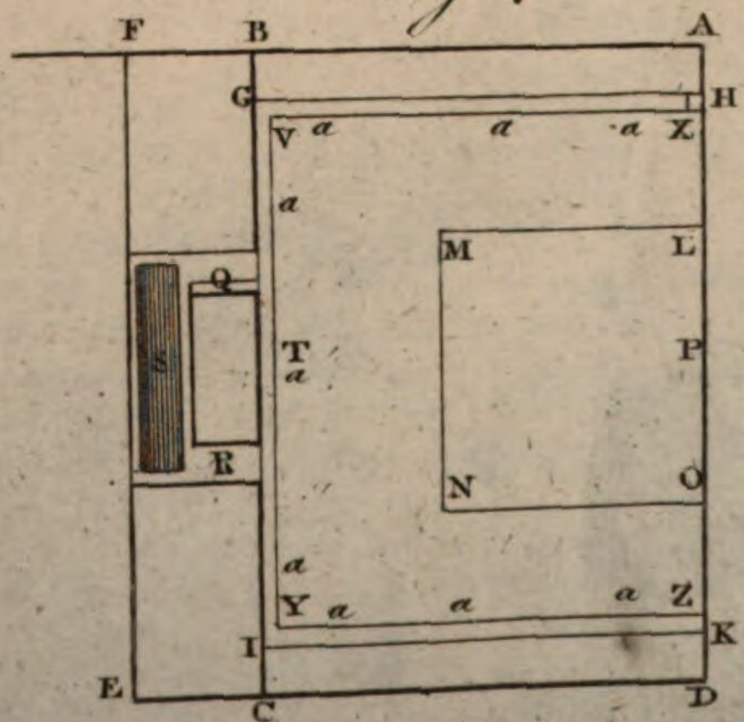


Fig. 4.



Sphegos.

A Bell Print. Walsall sculpter fecit.

Spinning || Spinoza.

proper for the ſeveral kinds of working. Hemp, flax, nettle-thread, and other like vegetable matters, are to be wetted in ſpinning: ſilks, wools, &c. are ſpun dry, and do not need water; yet there is a way of ſpinning or reeling ſilk as it comes off the caſes or balls, where hot and even boiling water is to be uſed (ſee SILK). The vaſt variety, and the importance of thoſe branches of our manufactures, which are produced from cotton, wool, and flax, ſpun into yarn, together with the cheapneſs of proviſions, and the low price of labour in many foreign countries, which are our rivals in trade, have occaſioned many attempts at home to render ſpinning more eaſy, cheap, and expeditious. For which ſee *COTTON Spinning* and *COTTON Mills*.

Tranſ. of the Society for the encouragement of Arts, &c.

Theſe contrivances have in ſome parts of Scotland been applied to the ſpinning of flax; but a very conſiderable improvement has lately been made by Mr Antis of Fulneck near Leeds of the common ſpinning wheel. It is well known, that hitherto much time has been loſt by ſtopping the wheel in order to ſhift the thread from one ſtaple on the flyer to another; but in Mr Antis's wheel the bobbin is made to move backwards and forwards, ſo as to prevent the neceſſity of this perpetual interruption, as well as to obviate the danger of breaking the thread and loſing the end. This is effected by the axis of the great wheel being extended through the pillar next the ſpinner, and formed into a pinion of one leaf A, which takes into a wheel B, ſeven inches diameter, having on its periphery 97 teeth; ſo that 97 revolutions of the great wheel cauſe one of the leſſer wheel. On this leſſer wheel is fixed a ring of wire *ccc*; which, being ſupported on ſix legs, ſtands obliquely to the wheel itſelf, touching it at one part, and projecting nearly three quarters of an inch at the oppoſite one: near the ſide of this wheel is an upright lever C, about 15 inches long, moving on a centre, three inches from its lower extremity, and connected at the top to a ſliding bar D; from which riſes an upright piece of braſs E, which working in the notch of a pulley drives the bobbin F backward and forward, according as the oblique wire forces a pin G in or out, as the wheel moves round. To regulate and aſſiſt the alternate motion, a weight H hangs by a line to the ſliding bar, and paſſing over a pulley I riſes and falls as the bobbin advances or recedes, and tends conſtantly to keep the pin in contact with the wire. It is evident, from this deſcription, that one ſtaple only is wanted to the flyer; which, being placed near the extremity K, the thread paſſing through it is by the motion of the bobbin laid regularly thereon. For this invention the Society inſtituted at London for the Encouragement of Arts, &c. gave the author a premium of twenty guineas.

Plate CCCCLXXIV.

SPINOSUS CAULIS, in botany; a ſtem covered with ſtrong woody prickles, whoſe roots are not ſuperficial, but proceeding from the body of the ſtem. When applied to a leaf, *ſpinoſum folium*, it indicates the margin running out into rigid points or prickles, *quod margine exit in acumina duriora, rigida, pungentia*.

SPINOUS, in botany. See SPINOSUS.

SPINOUS Fiſhes, ſuch as have ſome of the rays of the back-fins running out into thorns or prickles, as the perch, &c.

SPINOZA (Benedict), was born at Amſterdam the 24th November 1632. His father was a Jew of Portugal, by profeſſion a merchant. After being taught Latin by a phyſician, he applied himſelf for many years to the ſtudy of theology, and afterwards devoted himſelf entirely to philoſophy. He began very early to be diſſatisfied with the Jewiſh religion; and as his temper was open, he did not conceal his doubts from the ſynagogue. The Jews, it is ſaid, offered to tolerate his infidelity, and even promiſed him a penſion of a thouſand dollars *per annum*, if he would remain in their ſociety, and continue outwardly to practiſe their ceremonies. But if this offer was really made, he rejected it, perhaps from his averſion to hypocriſy, or rather becauſe he could not endure the reſtraint which it would have impoſed. He alſo refuſed the legacy of a very conſiderable fortune, to the prejudice of the natural heirs; and he learned the art of poliſhing glaſs for ſpectacles, that he might ſubſiſt independently of every one. Spinoza.

He would probably have continued in the ſynagogue for ſome time longer, if it had not been for an accident. As he was returning home one evening from the theatre, he was ſtabbed by a Jew: the wound was ſlight; but the attempt naturally led Spinoza to conclude that the Jews had formed the deſign of aſſaſſinating him. After leaving the ſynagogue, he became a Chriſtian, and frequented the churches of the Lutherans and Calviniſts. He now devoted himſelf more than ever to his favourite philoſophical ſpeculations; and finding himſelf frequently interrupted by the viſits of his friends, he left Amſterdam, and ſettled at the Hague, where he often continued for three months together without ever ſtirring from his lodging. During his reſidence in that city, his hoſteſs, who was a Lutheran, aſked him one day if ſhe could be ſaved while ſhe continued in her religion? "Yes (replied Spinoza), provided you join to your religion a peaceable and virtuous life." From this anſwer it has been concluded that he was a Chriſtian in appearance only, while in reality he regarded all religions as indifferent. But this concluſion would be too ſevere, even if the woman had been a Mahometan. His *Tractatus Theologico-politicus*, which was publiſhed about that time, is a better proof of his inſincerity than a thouſand ſuch concluſions; for this book contains all thoſe doctrines in embryo which were afterwards unfolded in his *Opera Poſthuma*, and which are generally conſidered as a ſyſtem of atheiſm.

His fame, which had now ſpread far and wide, obliged him ſometimes to interrupt his philoſophical reveries. Learned men viſited him from all quarters. While the prince of Condé commanded the French army in Utrecht, he intreated Spinoza to viſit him; and though he was abſent when the philoſopher arrived, he returned immediately, and ſpent a conſiderable time with him in converſation. The elector Palatine offered to make Spinoza profeſſor of philoſophy at Heidelberg; which, however, he declined.

He died of a conſumption at the Hague on the 21ſt February 1677, at the age of 45. His life was a perpetual contradiction to his opinions. He was temperate, liberal, and remarkably diſintereſted; he was ſociable, affable, and friendly. His converſation was agreeable and inſtructive, and never deviated from the ſtricteſt propriety.

The only edition of the works of Spinoza that we have ſeen is in two volumes ſmall 4to; the former of

Spinoza. which was printed at Hamburg in the year 1670, and the latter we know not where, in 1677, a few months after his death. In the *Tractatus Theologico-politicus*, already mentioned, he treats of *prophecy* and *prophets*; and of the *call of the Hebrews*, whom he affirms to have been diſtinguiſhed from other nations only by the admirable form of their government, and the fitneſs of their laws for long preſerving their political ſtate. He is likewiſe of opinion, or at leaſt pretends to be ſo, that God may, in what we call a *ſupernatural way*, have given political inſtitutes to other nations as well as to the Hebrews, who were, he ſays, at no time a peculiar people to the Supreme Lord of heaven and earth; for, according to him, all hiſtory, ſacred and profane, teſtifies that every nation was bleſſed with the light of prophecy. That light indeed, if his notions of it be juſt, was of very little value. He labours to prove, that the prophets were diſtinguiſhed from other men only by their piety and virtue; that their revelations depended wholly on their imaginations and the diſpoſitions of their minds; that they were often groſsly ignorant and highly prejudiced; that the ſpeculative opinions of one prophet are ſeldom in uniſon with thoſe of another; and that their writings are valuable to us only for the excellent rules which he acknowledges they contain reſpecting the practice of piety and virtue. He then proceeds to treat of the divine law and of miracles; and endeavours to prove that no miracle, in the proper ſenſe of the word, can have been at any time performed; becauſe every thing happens by a neceſſity of nature, the reſult of the divine decrees, which are from all eternity neceſſary themſelves. He acknowledges, that in the Scriptures, which he profeſſes to admit as true hiſtory, miracles are often mentioned; but he ſays that they were only ſingular events which the ſacred hiſtorians *imagined* to be miraculous: and he then gives ſome very extraordinary rules for interpreting the books of the Old and New Teſtaments where they treat of miracles, or appear to foretel future events. See our articles MIRACLE and PROPHECY.

Having thus diveſted the Scriptures of every thing characteriſtic of a revelation from heaven, he next calls in queſtion their authenticity. He affirms, in contradiction to the cleareſt internal evidence, that the Pentateuch and all the other hiſtorical books muſt have been written by one man; and that man, he thinks, could not have flouriſhed at a period earlier than that of Ezra. The grounds of this opinion are unworthy of the talents of Spinoza; for that he had talents is incontrovertible. His principal objection to the authenticity of the Pentateuch is, that Moſes is made to ſpeak of himſelf in the third perſon, and to talk of the Canaanites being then in the land; and becauſe he finds in his writings, as well as in the books of Joſhua, Judges, Ruth, Samuel, &c. places deſigned by names which he ſuppoſes they had not in the early ages of which theſe books contain the hiſtory, he concludes that theſe writings muſt be one compilation from ancient records made at a very late period; more eſpecially as the author often ſpeaks of things of great antiquity remaining to this day. The books of Eſther, Ezra, Nehemiah, and Chronicles, muſt have been compiled, he thinks, under the Maccabees; and he ſeems to conſider as of equal value with them the ſtory of Tobit, and the other two apocryphal treatiſes intitled the Wiſdom of Solomon and Eccleſiaſticus. Spinoza.

Theſe ſenſeleſs cavils, worthy only of one of thoſe modern freethinkers whoſe learning, in the opinion of Biſhop Warburton, is not ſufficient to carry them even to the confines of rational doubt, we have ſufficiently obviated in another place (ſee SCRIPTURE, n° 8—31.) Spinoza urges them againſt the other books of the Old Teſtament. The prophecies of Iſaiah, Jeremiah, Ezekiel, Daniel, Hoſea, and Jonah, are, as we have them, only fragments, he ſays, of the writings of thoſe men compiled by the Phariſees under the ſecond temple from ancient and voluminous records.

In the midſt of this dogmatical ſcepticiſm, if we may uſe ſuch a phraſe, he bears ſuch a teſtimony to the laſt chapters of the book of Daniel, as we ſhould not have looked for in the writings either of a Jew or of a Deiſt. After detailing the various hypotheſes which in his time were held reſpecting the author and the intention of the book of *Job*; in which, he ſays, MOMUS is called SATAN, he proceeds in theſe words: "Tranſeo ad Danielis librum; hic ſine dubio ex cap. 8. ipſius Danielis ſcripta continet. Undenam autem priora ſeptem capita deſcripta fuerint, neſcio*;" thus admitting the famous prophecy of the ſeventy weeks. The canon of the Old Teſtament, he ſays, was finally ſettled by rabbins of the Phariſaical ſect, who wiſhed to exclude from it the books of *Proverbs*, *Eccleſiaſtes*, and *Ezekiel*, as they had actually excluded others of equal value; but the three books in queſtion were inſerted by the influence of two of the rabbis of greater wiſdom and integrity than the reſt.

* *Tractatus*, cap. x. p. 130.

That ſo paradoxical a writer, who had been originally a Jew, and was now almoſt a Deiſt, ſhould have treated the New Teſtament with as little ceremony as the Old, will not ſurpriſe the intelligent reader. He begins his remarks, however, with affirming, that no man can peruſe the Chriſtian Scriptures, and not acknowledge the apoſtles to have been prophets; but he thinks that their mode of propheſying was altogether different from that which prevailed under the Moſaic diſpenſation; and that the gift, whatever it was, forſook them the inſtant that they left off *preaching*, as their *writings* have to him every appearance of human compoſitions. This diſtinction between Chriſtian and Jewiſh prophecy is the more wonderful, that he founds it principally on the diſſimilarity of *ſtyle* viſible in the writings of the Old and New Teſtaments; though, in his ſecond chapter, which treats of the works of the Jewiſh prophets, he ſays expreſsly, "Stylus deinde prophetiæ pro eloquentia cujuſque prophetæ variabat, prophetiæ enim Ezekielis et Amoſis non ſunt, ut illæ Eſaiæ, Nachumi eleganti, ſed rudiore ſtylo ſcriptæ." That the Hebrew ſcholar may be convinced of the truth of this remark, he recommends to him to ſtudy diligently the writings of theſe prophets, and to conſider the occaſions on which their prophecies were uttered: "Quæ ſi omnia recte perpendentur (ſays he) facile oſtendant, Deum nullum habere ſtylum peculiarem dicendi, ſed tantum pro eruditione, et capacitate prophetæ eatenus eſſe elegantem, compendioſum, ſeverum, rudem, prolixum, et obſcurum." Another objection brought by Spinoza againſt the prophecies of the New Teſtament ariſes from the authors of them having been

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Spinoza. at all times masters of themselves. This, says he, was peculiarly the case of St Paul, who often confirms his doctrine by *reasoning*, which the Jewish prophets never condescended to do, as it would have submitted their dogmas to the examination of *private judgment*. Yet, with singular inconsistency, he affirms, that the Jewish prophets could not know that the impressions made on their imaginations proceeded from God, but by a sign given them, which by their own *reason* or *judgment* they knew would never be vouchsafed to an impious or a wicked man.

After these very free remarks on the Scriptures of the Old and New Testaments, he naturally enough expresses a suspicion, that by those who consider the Bible as the epistle of God sent from heaven to men, he will be thought to have sinned against the Holy Ghost by vilifying his dictates. This leads him to inquire in what sense the Scriptures are the word of God; and he gravely determines them to be so only as they *actually* contribute to make men more virtuous and holy. It is not enough that they are *calculated* to improve virtue and holiness: for should the words of the languages in which they are written acquire in process of time a signification different from what they had originally; should mankind lose all knowledge of these languages; or even should they agree to neglect the books, whether from ignorance or from wilfulness—those books would cease to be the word of God, and become nothing better than waste paper and ink; just as the two tables, which Moses broke on observing the idolatry of his countrymen, were not the covenant between Jehovah and the Israelites, but merely two pieces of stone! The Scriptures, however, are the word of God, because they teach the true religion of which God is the author; and they have taught it in such a manner, he says, that it can never be lost or corrupted whatever become of the books of the Old and New Testaments, or of the languages in which they are written. The whole of religion, as the Scriptures themselves testify, consists in the love of God above all things, and of our neighbours as ourselves: whence it follows, that we must believe that God exists, and watcheth over all things by his providence; that he is omnipotent, and has decreed the pious to be ultimately happy, and the impious miserable; and that our final salvation depends solely on His grace or favour. These truths, with their necessary consequences, are the word of God: they are clearly taught in the Scriptures, and can never be corrupted; but every thing else in these volumes is vain, he says, and of no greater importance to us than facts related in any other ancient and authentic history.

Such are the opinions which were entertained of revelation by a man whom a critic, writing in a Christian country, and professing to be a zealous Christian himself, has lately pronounced to have been a *chosen vessel*. For what purpose he was *chosen* it is not easy to conceive. His religion, as it appears in the *Tractatus*, is the worst kind of Deism; and his politics are such as our monthly critics are not wont to teach, and such as we trust shall never be seriously taught by any British subject. By the law of nature, he says, every man before the formation of civil government has an unquestionable right to whatever appears eligible either to his reason or to his appetites; and may get possession of it by *intreaty*, by *violence*, by *fraud*, or by *any other means* attended with less trouble to himself (*sive vi, sive dolo, sive precibus, sive quocunque demum modo facilius poterit*); and may treat as an enemy every person who shall attempt to obstruct his purpose. But when men agree to devolve this right upon others, and to constitute a political state, which both reason and appetite must persuade them to do, then are they in duty bound to obey every mandate of the government, however absurd it may be (*omnia mandata tametsi absurdissima*), as long as that government can enforce its edicts, and no longer; for, according to him, right and power are so inseparably united, that when a government loses its power, it has no longer the smallest claim to obedience. This doctrine, he says, is most *obviously* just when taught of democratical governments; but it is in fact equally true of monarchies and aristocracies: "Nam quisquis summam habet potestatem, sive unus sit, sive pauci, sive denique omnes, certum est ei summum jus *quicquid velit imperandi*, competere: et præterea quisquis potestatem se defendendi, sive sponte, sive *vi coactus*, in alium transtulit, eum suo jure naturali plane cessisse, et consequenter eidem ad omnia absolutè parere decreviisse quod omnia præstare tenetur, quamdiu rex, sive nobiles, sive populus summam, quam acceperunt, potestatem, quæ juris transferendi fundamentum fuit, conservant; nec his plura addere opus est*." We heartily agree with him, that to this precious conclusion it is needless to add a single word. Spinoza.

* *Tract.* cap. xvi. p. 181.

Taking our leave therefore of his *Tractatus Theologico-politicus*, we shall now give our readers a short account of his *Opera Posthuma*. These consist of, 1. ETHICA, *more geometrico demonstrata*; 2. POLITICA; 3. DE EMENDATIONE INTELLECTUS; 4. EPISTOLÆ, *et ad eas* RESPONSIONES; 5. COMPENDIUM GRAMMATICES LINGUÆ HEBRÆÆ.

The ETHICA are divided into five parts, which treat in order, *de* DEO; *de natura et origine* MENTIS; *de origine et natura* AFFECTUUM; *de* SERVITUTE *humana, seu de* AFFECTUUM VIRIBUS; *de* POTENTIA INTELLECTUS, *seu de* LIBERTATE *humana*. As the author professes to tread in the footsteps of the geometers, and to deduce all his conclusions by rigid demonstration from a few self-evident truths, he introduces his work, after the manner of Euclid, with a collection of *definitions* and *axioms*. These are couched in terms generally ambiguous; and therefore the reader will do well to consider attentively in what sense, if in any, they can be admitted; for it will not be found easy to grant his premises, and at the same time refuse his conclusions. His definition of substance, for instance, is so expressed as to admit of two senses; in one of which it is just, whilst in the other it is the parent of the most impious absurdity. We shall give it in his own words: "Per substantiam intelligo id, quod in se est, et per se concipitur: hoc est id, cujus conceptus non indiget conceptu alterius rei, a quo formari debeat." If by this be meant, that a substance is that which we can conceive by itself without *attending* to any thing else, or *thinking* of its formation, the definition, we believe, will be admitted by every reflecting mind as sufficiently distinguishing the thing defined from an attribute, which, he says, is that which we perceive *of* a substance, and which we certainly cannot conceive as existing by itself. Thus the writer of this article can shut his eyes and contemplate in idea the small 4to volume now before

Spinoza. fore him, without attending to any thing elſe, or thinking of its paradoxical author, or even of the Great Being who created the matter both of him and of it; but he cannot for an inſtant contemplate the yellow colour of its vellum boards without thinking of triple extenſion, or, in other words, of body. The book therefore is a *ſubſtance*, becauſe conceivable by itſelf; the colour is an *attribute* or *quality*, becauſe it cannot be conceived by itſelf, but neceſſarily leads to the conception of ſomething elſe. But if Spinoza's meaning be, that nothing is a ſubſtance but what is conceived as exiſting from eternity, independent of every thing as a cauſe, his definition cannot be admitted: for every man conceives that which in himſelf thinks, and wills, and is conſcious, as a ſubſtance; at the ſame time that he has the beſt evidence poſſible that he exiſted not as a conſcious, thinking, and active being, from eternity.

His fourth axiom is thus expreſſed: "Effectus cognitio a cognitione cauſæ dependet, et eandem involvit;" and his fifth, "Quæ nihil commune cum ſe invicem habent, etiam per ſe invicem intelligi non poſſunt, ſive conceptus unius alterius conceptum non involvit." The former of theſe propoſitions, ſo far from being ſelf-evident, is not even true; and the latter is capable of two ſenſes very different from each other. That every effect proceeds from *a cauſe*, is indeed an axiom; but ſurely we may know the effect accurately, though we be ignorant of the *particular* cauſe from which it proceeds (ſee PHILOSOPHY, n° 36; and PHYSICS, n° 91, &c.); nor does the knowledge of the one by any means involve the knowledge of the other. If different things have nothing in common, it is indeed true that the knowledge of one of them will not give us an *adequate conception* of the other; but it will in many caſes compel us to believe, that the other *exiſts* or has exiſted. A parcel of gunpowder lying at reſt has nothing in common with the velocity of a cannon-ball; yet when we know that a ball has been driven with velocity from a cannon, we infer with certainty that there has been a parcel of powder at reſt in the chamber of that cannon.

It is upon ſuch ambiguous definitions and axioms as theſe that Spinoza has raiſed his pretended demonſtrations, that one ſubſtance cannot produce another; that every ſubſtance muſt neceſſarily be infinite; that no ſubſtance exiſts or can be conceived beſides God; and that extended ſubſtance or body is one of the infinite *attributes* of God. We ſhall not waſte our own time or the reader's with a formal confutation of theſe impious abſurdities. We truſt they are ſufficiently confuted in other articles of this work (ſee METAPHYSICS, Part III. PROVIDENCE, and THEOLOGY, Part I.); and whoever wiſhes for a more particular examination of the author's principles, may find it in Dr Clarke's Demonſtration of the Being and Attributes of God. The truth, however, is, that no man will need the aſſiſtance of that eminent metaphyſician to diſcover the fallacy of the reaſoning by which they are attempted to be proved, if he affix *any one preciſe meaning* to the definitions and axioms, and adhere to that meaning ſteadily thro' the whole proceſs of the pretended demonſtrations.

By way of apology for this jargon, it has been lately ſaid, that "Spinoza takes the word *ſubſtance* in its moſt ſimple and perfect ſenſe; which is neceſſary, as he writes mathematically, and propoſes a ſimple idea as the foundation of his theory. What is the proper ſignification of a ſubſtance? Is it not that which ſtands alone, which has the cauſe of its exiſtence within itſelf? I wiſh that this ſimple meaning of the word could be univerſally admitted in philoſophy. Strictly ſpeaking, no worldly thing is a ſubſtance; ſince all mutually depend on each other, and finally on God, who, in this exalted ſenſe, is the only *ſubſtance*. The word *modification* ſounds harſh and improper, and therefore it cannot be expected to gain a place in philoſophy; but if the ſchool of Leibnitz may term matter the *appearance of ſubſtances*, why may not Spinoza be allowed a bolder term? Worldly ſubſtances are kept in union by divine power, as it was by divine power that they had exiſtence. They repreſent alſo, if you pleaſe, *modified* appearances of divine power; each according to the ſtation, the time, and the organs, in and with which it appears. The phraſe uſed by Spinoza is conciſe, and it gives an unity and ſimplicity to his whole ſyſtem, however ſtrange it may ſound in our ears." Spinoza. *Herder's Dialogues concerning God.*

From this account of Spinoziſm, one who had never looked into the works of the author would be led to ſuppoſe that his ſyſtem is the ſame with that of Berkeley; which, denying the exiſtence of material ſubſtance, attributes all our perceptions of what we call the qualities of body to the immediate agency of the Deity on our minds (ſee METAPHYSICS, Part II. Chap. 3.) But Spinoza's doctrine is very different. According to him, bodies are either attributes or affections of God; and as he ſays there is but one extended ſubſtance, he affirms that ſubſtance to be indiviſible, and employs a long ſcholium† to prove that thoſe are miſtaken who ſuppoſe it finite and not *eſſential to the Deity*. That we do not miſrepreſent his ſentiments, the learned reader will be convinced by the two following definitions, with which he introduces that part of his ethics which treats of the nature and origin of mind. 1. "Per corpus intelligo modum, qui Dei eſſentiam, quatenus, ut res extenſa conſideratur, certo et determinato modo exprimit." 2. "Ad eſſentiam alicujus rei id pertinere dico, quo dato res neceſſario ponitur, et quo ſublato res neceſſario tollitur; vel id, ſine quo res, et vice verſa quod ſine re nec eſſe nec concipi poteſt." In conformity with theſe definitions, he attempts to prove that God is an extended as well as a thinking ſubſtance; that as a thinking ſubſtance he is the cauſe of the *idea* of a circle, and as an extended ſubſtance of the *circle* itſelf; and that the minds of men are not ſubſtances, but certain modifications of the divine attributes; or, as he ſometimes expreſſes it, "Quod humanæ mentis actuale conſtituit, eſt idea rei ſingularis actu exiſtentis." Hence, he ſays, it follows that the human mind is a part of the intellect of the infinite God; ſo that when we ſpeak of the human mind perceiving this or that, we can only mean that God, not as he is infinite, but as he appears in the human mind or conſtitutes its eſſence, has this or that idea; and when we ſpeak of God's having this or that idea, we muſt conceive of Him not only as conſtituting the human mind, but as, together with it, having the idea of ſomething elſe (A). In another place he tells us, that the human mind is nothing but the *idea* which

† See his Prop. xv. &c. Prop. ii. vii. xi. Part 2.

(A) Hinc ſequitur mentem humanam partem eſſe infiniti intellectus Dei; ac proinde cum dicimus, mentem humanam

Spinoza. which God has of the human body as actually existing; that this *idea* of the body, and the *body* itself, are one and the same thing; and that thinking and extended substances are in reality but one and the same substance, which is sometimes comprehended under one attribute of the Deity, and sometimes under another*.

* Prop. vii. xiii. xxi. Part 2.

If this impious jargon be not Atheism, or as it has been sometimes called Pantheism, we know not what it is (see PANTHEISM). According to Spinoza, there is but one substance, which is extended, infinite, and indivisible. That substance indeed he calls God; but he labours to prove that it is corporeal; that there is no difference between mind and matter; that both are attributes of the Deity variously considered; that the human soul is a part of the intellect of God; that the same soul is nothing but the idea of the human body; that this idea of the body, and the body itself, are one and the same thing; that God could not exist, or be conceived, were the visible universe annihilated; and therefore that the visible universe is either the one substance, or at least an essential attribute or modification of that substance. He sometimes indeed speaks of the *power* of this substance; but when he comes to explain himself, we find that by power he means nothing but blind necessity ‡; and though he frequently talks of the *wisdom* of God, he seems to make use of the word without meaning. This we think evident from the long appendix to his 36th proposition; in which he labours to prove that the notion of final causes is an idle figment of the imagination, since, according to him, nothing but the prejudices of education could have led men to fancy that there is any real distinction between *good* and *evil*, *merit* and *demerit*, *praise* and *reproach*, *order* and *confusion*; that *eyes* were given them that they might be enabled to *see*; *teeth* for the purpose of chewing their *food*; *herbs* and *animals* for the *matter* of that *food*; that the *sun* was formed to give *light*, or the *ocean* to nourish *fishes*. If this be true, it is impossible to discover wisdom in the operations of his *one substance*; since, in common apprehension, it is the very characteristic of folly to act without any end in view.

‡ Prop. xxxiii. Part 1.

Such are the reveries of that writer, whose works a German philosopher of some name has lately recommended to the public, as calculated to convey to the mind more just and sublime conceptions of God than are to be found in most other systems. The recommendation has had its effect. A literary journalist of our own, reviewing the volume in which it is given, feels a peculiar satisfaction from the discovery that Spinoza, instead of a formidable enemy to the cause of virtue and religion, was indeed their warmest friend; and piously hopes that we shall become more cautious not to suffer ourselves to be deceived by empty names, which those who *cannot* reason (Sir Isaac Newton and Dr Clarke perhaps) give to those who can (Hobbes, we suppose, and Spinoza). But though we have the honour to think on this question with our illustrious countrymen, we have no desire to depict Spinoza as a *reprobate*, which the critic says has often been done by ignorance and enthusiasm. We admit that his conduct in active life was irreproachable; and for his speculative opinions, he must stand or fall to his own Master. His *Ethics* appear to us indeed a system shockingly impious; and in the tract intitled POLITICA, *power* and *right* are confounded as in the former volume; but in the treatise DE INTELLECTUS EMENDATIONE, are scattered many precepts of practical wisdom, as well as some judicious rules for conducting philosophical investigation; and we only regret, that the reader must wade to them through pages of fatalism, scepticism, and palpable contradictions. His *Compendium Grammatices Linguæ Hebrææ*, though left imperfect, appears to have so much merit, that it is to be wished he had fulfilled his intention of writing a philosophical grammar of that language, instead of wasting his time on abstruse speculations, which, though they seem not to have been injurious to his own virtue, are certainly not calculated to promote the virtue of others, or to increase the sum of human happiness.

Spinoza || Spirit.

SPIRÆA, in botany: A genus of plants belonging to the class of *icosandria*, and to the order of *pentagynia*; and in the natural system arranged under the 26th order, *Pomaceæ*. The calyx is quinquefid; there are five petals; and the capsule is polyspermous. There are 18 species; of which two only are British, the filipendula and ulmaria. 1. The *filipendula*, dropwort, has pinnated leaves; the leaflets are serrated; the stalk is herbaceous, about a foot and a half high, terminated with a loose umbel of white flowers, often tinged with red. The petals are generally six, and the segments of the calyx are reflexed: the stamina are 30 or more; the germina 12 or upwards. It grows in mountainous pastures. 2. The *ulmaria*, meadow-sweet. The leaves have only two or three pair of pinnæ, with a few smaller ones intermixed; the extreme one being larger than the rest, and divided into three lobes. The calyx is reddish; the petals white, and the number of capsules from six to ten twisted in a spiral. The tuberous pea, like roots of the filipendula dried and reduced to powder, have been used instead of bread in times of scarcity. Hogs are very fond of these roots. Cows, goats, sheep, and swine, eat the plant; but horses refuse it. The flowers of the ulmaria have a fragrant scent, which rises in distillation. The whole plant indeed is extremely fragrant, so that the common people of Sweden strew their floors with it on holidays. It has also an astringent quality, and has been found useful in dysenteries, ruptures, and in tanning of leather.

SPIRAL, in geometry, a curve line of the circular kind, which in its progress recedes from its centre.

SPIRE, in architecture, was used by the ancients for the base of a column, and sometimes for the astragal or tore; but among the moderns it denotes a steeple that continually diminishes as it ascends, whether conically or pyramidally.

SPIRIT, in metaphysics, an incorporeal being or intelligence;

humanam hoc vel illud percipere, nihil aliud dicimus quam quod Deus, non quatenus infinitus est, sed quatenus per naturam humanæ mentis explicatur, sive quatenus humanæ mentis essentiam constituit, hanc vel illam habet ideam: et cum dicimus Deum hanc vel illam ideam habere, non tantum, quatenus naturam humanæ mentis constituit; sed quatenus simul cum mente humana alterius rei etiam habet ideam. *Corol.* prop. xi. part 2.

Spirit || Spirituous Liquors.

intelligence; in which ſenſe God is ſaid to be a ſpirit, as are angels and the human ſoul. See METAPHYSICS, Part III.

SPIRIT, in chemiſtry and pharmacy, a name applied to every volatile liquid which is not inſipid like phlegm or water; and hence the diſtinction into acid, alkaline, and vinous ſpirits. See PHARMACY-*Index*.

SPIRIT of Wine. See CHEMISTRY-*Index*, DISTILLATION, and PHARMACY-*Index*.

SPIRITS, or ANIMAL SPIRITS. See ANATOMY, Part V. n° 136, and PHYSIOLOGY, n° 185.

SPIRITUAL, in general, ſomething belonging to or partaking of the nature of ſpirit. See SPIRIT.

SPIRITUOUS LIQUORS have in all nations been conſidered as a proper ſubject of heavy taxation for the ſupport of the ſtate. This has naturally occaſioned a nice examination of their ſtrength. It having been at laſt found that this was intimately connected with the ſpecific gravity, this has been examined with the moſt ſcrupulous attention to every circumſtance which could affect it, ſo that the duties might be exactly proportioned to the quantity of ſpirit in any ſtrong liquor, independent on every other circumſtance of flavour or taſte, or other valued quality. The chemiſt at laſt found that the baſis of all ſtrong liquors is the ſame, produced by the vinous fermentation of pure ſaccharine matter diſſolved in water. He alſo found, that whether this vegetable ſalt be taken as it is ſpontaneouſly formed in the juices of plants and fruits, or as it may be formed or extricated from farinaceous fruits and roots by a certain part of the proceſs of vegetation, it produces the ſame ardent ſpirit, which has always the ſame denſity in every mixture with water. The minute portions of aromatic oils, which are in ſome degree inſeparable from it, and give it a different flavour according to the ſubſtance from which it was obtained, are not found to have any ſenſible effect on its denſity or ſpecific gravity. This ſeems very completely eſtabliſhed in conſequence of the unwearied attempts of the manufacturers to leſſen the duties payable on their goods by mixtures of other ſubſtances, which would increaſe their denſity without making them leſs palatable. The vigilance of the revenue officers was no leſs employed to detect every ſuch contrivance. In ſhort, it is now an acknowledged point, that the ſpecific gravity is an accurate teſt of the ſtrength.

But though this is true in general, we cannot derive much benefit from it, unleſs we know the preciſe relation between the ſtrength and the denſity of a ſpirituous liquor. Do they increaſe *pari paſſu*, or by what law are they connected? It was natural to expect that equal additions of ardent ſpirits or alcohol to a given quantity of water would produce equal diminutions of denſity. Areometers were accordingly made on this principle above 200 years ago, as may be ſeen in the works of Gaſpar Schottus, Sturmius, Agricola, and other old authors. But when mathematical phyſics became more generally known, this was eaſily diſcovered to be erroneous; and it was ſhown (we think firſt by Mr Boyle) that equal additions to the ſpecific gravity would be produced by ſucceſſively taking out of any veſſel a certain meaſure of alcohol and replacing it with an equal meaſure of water. This was the moſt convenient diſcovery for all parties, becauſe then the duties payable on a caſk of ſpirits would be in the exact proportion of the diminution of its denſity. But it was ſoon found by thoſe who were appointed guardians of the revenue that this concluſion was erroneous, and that a mixture which appeared by this rule to contain 35 gallons of alcohol, did really contain 35½. This they found by actually making ſuch a mixture: 18 gallons of alcohol mixed with 18 of water produced only 35 gallons of ſpirits. The revenue officers, finding that this condenſation was moſt remarkable in mixtures of equal parts of water and the ſtrongeſt ſpirits which could then be procured, determined to levy the duties by this mixture; becauſe, whether the ſpirituous liquor was ſtronger or weaker than this, it would appear, by its ſpecific gravity, rather ſtronger than it really was. This ſagacious obſervation, and the ſimplicity of the compoſition, which could at all times be made for compariſon, ſeem to be the reaſons for our exciſe offices ſelecting this mode of eſtimating the ſtrength and levying the duties. A mixture of nearly equal meaſures of water and alcohol is called PROOF SPIRIT, and pays a certain duty *per* gallon; and the ſtrength of a ſpirituous liquor is eſtimated by the gallons, not of alcohol, but of proof ſpirit which the caſk contains. But becauſe it might be difficult to procure at all times this proof ſpirit for compariſon, ſuch a mixture was made by order of the board of exciſe: and it was found, that when ſix gallons of it was mixed with one gallon of water, a wine gallon of the mixture weighed 7 pounds 13 ounces avoirdupois. The board therefore declared, that the ſpirituous liquor of which the gallon weighed 7 pounds 13 ounces ſhould be reckoned 1 to 6 or 1 in 7 under proof. This is but an aukward and complex formula; it was in order to ſuit matters to a mode of examination which had by time obtained the ſanction of the board. Mr Clarke, an ingenious artiſt of that time, had made a hydrometer incomparably more exact than any other, and conſtructed on mathematical principles, fit for computation. This had a ſet of weights correſponding to the additions of water or proof ſpirit, and the mixture 1 to 6 or 1 in 7 was the only one which weighed an exact number of ounces *per* gallon without a fraction.

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Thus ſtands the exciſe law; and Clarke's hydrometer is ſtill the inſtrument of authority, although others have been ſince conſtructed by DICAS, QUIN, and others, which are much more ingenious and convenient. The mathematician who examines Dicas's hydrometer, with its ſliding ſcale, by which it is adjuſted to the different temperatures, and points out the condenſations, will perceive a beautiful and ſagacious combination of quantities, which he will find it difficult to bring under any analytical formula. Perhaps Quin's may have ſome preference in reſpect of conveniency; but *facile inventis addere*. Mr Dicas's was original.

As naturaliſts became more accuſtomed to exact obſervation in every topic of inquiry, the condenſation which obtains in the mixture of different ſubſtances became more familiarly known. This evidently affects the preſent queſtion; and both the exciſe and the diſtillers are intereſted in its accurate deciſion. This occaſioned an application to the Royal Society; and a moſt ſcrupulous examination of the ſtrength of ſpirituous liquors was made by Sir Charles Blagden and Mr Gilpin, of which they have given a very particular account in the PHILOSOPHICAL TRANSACTIONS for 1790 and 1792.

We have taken notice of this in the article SPECIFIC GRAVITY,

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GRAVITY, mentioning ſuch circumſtances of the reſults as ſuited our purpoſes of phyſical diſcuſſion. At preſent we give the general reſult in the table of ſpecific gravity, as peculiarly belonging to ſpirituous liquors, affording the moſt exact account of their denſity in every ſtate of dilution of alcohol with water. And as the relation between the proportion of ingredients and the denſity is peculiar to every ſubſtance, ſo that ſcarcely any inference can be made from one to another, the reader will conſider the tables here given as characteriſtic with reſpect to alcohol. In all ſolutions of ſalts we found that the condenſation increaſes continually with the dilution, whereas it is greateſt when equal bulks of water and alcohol are mixed: yet we do not conſider this as an exception; for it is certain, that in the ſtrongeſt brine the ſaline ingredient bears but a ſmall proportion to the water—and when we mix two ſolutions, the condenſation is greateſt when they are nearly equal in bulk. But we think ourſelves entitled to infer, that alcohol is not a dilution of a ſubſtance in a quantity of water; but that water, in a certain proportion, not very diſtant from what we can produce by ſlow diſtillation, is an ingredient of alcohol, or is one of its component parts, and not merely a vehicle or menſtruum. We therefore imagine that proof ſpirit contains nearly equal bulks of water and ardent ſpirits.

The great difficulty in this examination aroſe from the very diſſimilar expanſions of water and alcohol by heat. This determined Sir Charles Blagden to eſtimate the proportions of ingredients by weight, and made it abſolutely neceſſary to give a ſcale of ſpecific gravity and ſtrength for every temperature. For it muſt be remarked, that the queſtion (whether in commerce or philoſophy) always is, "How many gallons of alcohol and of water, taken juſt now and mixed together, will produce a hundred gallons of the ſpirit we are examining?" The proportion of theſe two will be different according to the temperature of both. As many mixtures therefore muſt have been made in each proportion as there were temperatures conſidered; but by taking the ingredients by weight, and examining the denſity of the compound in one temperature, it is then heated and cooled, and its change of denſity obſerved. Calculation then can tell us the change in the proportion of the bulks or numbers of gallons in the mixture, by means of a previous table ſhowing the expanſions of water and of alcohol.

The alcohol ſelected for this examination had the ſpecific gravity 0,825. This is not the pureſt that can be procured; ſome was produced of 0,816, of 0,814, and 0,813, both obtained from rum, from brandy, and from malt ſpirit. We are informed that Dr Black has obtained it of the ſpecific gravity 0,8 by digeſting alcohol with fixed ammoniac (muriatic acid united with lime) made very dry. It dephlegmates alcohol very powerfully without decompoſing it, which always happens when we uſe cauſtic alkali. Alcohol of 0,825 was choſen becauſe expreſſed by a number of eaſy management in computation.

The examination commenced by aſcertaining the expanſions of water and alcohol. The temperature 60° of Fahrenheit's ſcale was ſelected for the general temperature of compariſon, being eaſily attainable even in cold weather, and allowing the examinator to operate at eaſe. The firſt and laſt copartments of the tables contain the weights and ſpecific gravities of alcohol and water for every fifth degree of heat from 30° to 100°. From theſe we have conſtructed the two following little tables of expanſion. The bulk of 1000 ounces, pounds, or other weight of water and of alcohol of the temperature 60°, occupies the bulks expreſſed in the tables for every other temperature. Water could not be eaſily or uſefully examined when of the temperature 30°, becauſe it is with great difficulty kept fluid in that temperature. It is very remarkable, that when it can be ſo kept, it expands inſtead of contracting; while cooling down from 35° or thereabouts, and as it approaches to 32°, it expands rapidly. We obſerve the ſame thing in the cryſtallization of Glauber ſalt, martial vitriol, and ſome others, which contain much water in their cryſtals. We obſerve, on the other hand, a remarkable contraction in the zeolite juſt before its beginning to ſwell into bubbles by a red heat.

Heat	Bulk of 100,000 ounces.			
	Of Water.		Of Alcohol.	
		Diff.		Diff.
30°			119195	
				319
35	99910		119514	
		— 4		325
40	99906		119839	
		+ 8		332
45	99914		120172	
		18		342
50	99932		120514	
		30		348
55	99962		120868	
		38		350
60	100000		121212	
		50		353
65	100050		121565	
		56		354
70	100106		121919	
		64		360
75	100170		122279	
		71		366
80	100241		122645	
		79		372
85	100320		123017	
		84		376
90	100404		123393	
		96		380
95	100500		123773	
		108		384
100	100608		124157	

This being premiſed, the examination was conducted in the following manner. It was determined to mix 100 parts by weight of pure alcohol with five, ten, fifteen, twenty, parts of diſtilled water, till they were compounded in equal quantities, and then to mix 100 parts of diſtilled water with 95, 90, 85, 80, &c. parts of alcohol, till they were mixed in the proportion of 100 to 5. Thus a ſeries of mixtures would be obtained, extending from pure alcohol to pure water. This ſeries would be ſuch, that the examinations would be moſt frequent in the caſes moſt uſual in the commerce of ſtrong liquors. A ſet of phials, fitted with ground ſtoppers, were provided, of ſizes fit to hold the intended mixtures. Theſe mixtures were made by ſuſpending the phial to the arm of a very nice balance, in the oppoſite ſcale of which (beſides the counterpoiſe of the phial) there was placed the weight 100. Spirit was then poured into the phial till it exactly balanced the weight 100. The weight for the water to be added was then put into the oppoſite ſcale, and water was poured into the phial by means of a ſlender glaſs funnel, by ſmall quantities at a time, and the phial frequently agitated to promote the mixture. When the additional weight was exactly balanced, the phial was taken off, its ſtopper put in, and leather tied over it, and it was ſet by, for at leaſt a month, that the mixture and the whole

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process of condensation might be completed. The same method was followed in the mixtures where the water was predominant.

When the ingredients of these mixtures were judged to have completely incorporated, their specific gravity was examined by weighing with the most scrupulous precision the contents of a vessel which held 2925 troy grains of water, of the temperature 60°. The balance was so exceedingly sensible, that the 50th part of a grain greatly deranged its position when loaded with the scales and their contents. It was constructed by Mr Ramsden, and some account of its exquisite sensibility may be seen in the *Journal de Physique*, vol. xxxiii. This quantity of materials was therefore thought abundantly sufficient for ascertaining the density of the liquor. It is needless to detail the precautions which were taken for having the contents of the weighing bottle brought to the precise temperature proper for the experiment. They were such as every person conversant with such things is accustomed to take—The bottle had a slender neck, and being put on a lathe, a mark was made round it with a diamond. The bottle was filled till the bottom of the hollow surface of the fluid was in the plane of this mark; and to judge of the accuracy attainable in filling the bottle, the operation was several times repeated and the contents weighed, without the difference of $\frac{1}{3}\frac{1}{0}$th of a grain in 2925. The only source of error which was to be guarded against was air-bubbles adhering to the inside of the bottle, or moisture condensing (in the experiments with low temperatures) on the outside. Both of these were attended to as much as possible.

This method of determining the specific gravity was preferred to the usual method, observing the weight lost by a lump of glass when suspended in water; for Mr Gilpin had been enabled, by means of this nice balance, to discover, even in pure water and in alcohol, a want of perfect fluidity. Something like viscidity rendered the motion of a lump of glass through the liquor sensibly sluggish, so that when the balance was brought to a level, there was not a perfect equilibrium of weights: (See what we have said of this matter in Specific Gravity). Mr Gilpin also tried the ingenious instrument proposed for such experiments by Mr Ramsden, and described by him in a pamphlet on this very subject; and he found the anomalies of experiment much greater than in this method by weighing.—Indeed the regular progression of weights to be seen in the annexed tables is an unquestionable proof of the sufficiency of the method; and it has the evident advantage of all other methods in point of simplicity and practicability without any uncommon apparatus. Any person possessed of a good ordinary balance and a set of exact weights may examine all questions of this kind, by weighing pure water and the liquor which he may have occasion to examine in a common 6 or 8 ounce phial. For this reason, it is recommended (in preference to all hydrometers) to the board of excise to provide this simple apparatus in every principal office.

Every experiment was made at least three times; and the mean result (which never differed one grain from the extreme) was taken.

From these experiments the annexed tables were constructed. The first is the simple abstract of the experiments, containing the weights of the contents of the bottle of every mixture. The second contains the specific gravities deduced from them.

We have said that the experiments appear surprisingly accurate. This we say on the authority of the regular progression of the specific gravity in any of the horizontal rows. In the series, for instance, for the temperature 60°, the greatest anomaly is in the mixture of 50 parts of spirit with 100 of water. The specific gravity is 95804, wanting 3 or 4 of the regular progression. This does not amount to 1 in 18000.

TABLE

TABLE I.—*Weights at the different Degrees of Temperature.*

Heat.	The pure Spirit.	100 grains of ſpirit to 5 grains of water.	100 grains of ſpirit to 10 grains of water.	100 grains of ſpirit to 15 grains of water.	100 grains of ſpirit to 20 grains of water.	100 grains of ſpirit to 25 grains of water.	100 grains of ſpirit to 30 grains of water.	100 grains of ſpirit to 35 grains of water	100 grains of ſpirit to 40 grains of water.	100 grains of ſpirit to 45 grains of water.	100 grains of ſpirit to 50 grains of water.	100 grains of ſpirit to 55 grains of water.	100 grains of ſpirit to 60 grains of water.	100 grains of ſpirit to 65 grains of water.
deg.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.
30	2487,35	2519,92	2548,42	2573,80	2596,66	2617,30	2636,23	2653,73	2669,83	2684,74	2698,51	2711,14	2722,89	2733,87
35	2480,87	2513,43	2541,84	2567,26	2590,16	2610,87	2629,92	2647,47	2663,64	2678,60	2692,43	2705,14	2716,92	2727,87
40	2474,30	2506,75	2535,41	2560,74	2583,66	2604,50	2623,56	2641,08	2657,23	2672,30	2686,32	2698,94	2710,81	2721,83
45	2467,62	2500,14	2528,75	2554,09	2577,10	2597,98	2617,03	2634,64	2650,87	2666,04	2679,99	2692,77	2704,57	2715,62
50	2460,75	2493,33	2521,96	2547,47	2570,42	2591,38	2610,54	2628,21	2644,43	2659,55	2673,64	2686,54	2698,42	2709,48
55	2453,80	2486,37	2515,03	2540,60	2563,64	2584,65	2603,80	2621,50	2637,86	2653,04	2667,14	2679,98	2691,83	2702,98
60	2447,00	2479,56	2508,27	2533,83	2556,90	2577,95	2597,22	2615,03	2631,37	2646,53	2660,62	2673,55	2685,52	2696,73
65	2440,12	2472,75	2501,53	2526,99	2550,22	2571,24	2590,55	2608,37	2624,75	2640,01	2654,04	2667,07	2679,15	2690,32
70	2433,23	2465,88	2494,56	2520,03	2543,32	2564,47	2583,88	2601,67	2617,96	2633,32	2647,52	2660,63	2672,74	2684,02
75	2426,23	2458,78	2487,62	2513,08	2536,39	2557,61	2576,93	2594,80	2611,19	2626,55	2640,81	2653,99	2666,06	2677,34
80	2419,02	2451,67	2480,45	2506,08	2529,24	2550,50	2569,86	2587,93	2604,29	2619,72	2633,99	2647,12	2659,36	2670,69
85	2411,92	2444,63	2473,33	2499,01	2522,29	2543,54	2563,01	2580,93	2597,45	2613,02	2627,39	2640,60	2652,78	2664,16
90	2404,90	2437,62	2466,32	2491,99	2515,28	2536,63	2556,11	2574,02	2590,60	2606,16	2620,52	2633,74	2646,00	2657,41
95	2397,68	2430,33	2459,13	2484,74	2508,10	2529,46	2549,13	2567,03	2583,65	2599,24	2613,57	2626,94	2639,25	2650,63
100	2390,60	2423,22	2452,13	2477,64	2500,91	2522,30	2541,92	2559,96	2576,56	2592,14	2606,50	2619,75	2632,17	2643,75

Heat	100 grains of ſpirit to 70 grains of water.	100 grains of ſpirit to 75 grains of water.	100 grains of ſpirit to 80 grains of water	100 grains of ſpirit to 85 grains of water.	100 grains of ſpirit to 90 grains of water.	100 grains of ſpirit to 95 grains of water.	100 grains of ſpirit to 100 grains of water.	95 grains of ſpirit to 100 grains of water.	90 grains of ſpirit to 100 grains of water.	85 grains of ſpirit to 100 grains of water.	80 grains of ſpirit to 100 grains of water.	75 grains of ſpirit to 100 grains of water.	70 grains of ſpirit to 100 grains of water.	65 grains of ſpirit to 100 grains of water.
deg.	Grains.	Grains.	Grains.	Grains	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.
30	2744,20	2753,75	2762,72	2771,08	2778,99	2786,36	2793,22	2799,85	2806,61	2813,85	2821,35	2828,90	2836,39	2844,16
35	2738,13	2747,74	2756,91	2765,32	2773,22	2780,59	2787,54	2794,19	2801,14	2808,52	2816,07	2823,68	2831,36	2839,26
40	2732,24	2741,86	2750,96	2759,50	2767,48	2774,90	2781,84	2788,69	2795,70	2803,17	2810,73	2818,36	2826,31	2834,40
45	2726,09	2735,77	2744,82	2753,36	2761,42	2768,85	2775,94	2782,99	2789,99	2797,45	2805,08	2812,93	2821,00	2829,28
50	2719,93	2729,64	2738,74	2747,27	2755,37	2762,95	2770,14	2777,19	2784,30	2791,72	2799,58	2807,56	2815,71	2824,12
55	2713,60	2723,51	2732,64	2741,24	2749,27	2756,83	2764,09	2771,29	2778,54	2785,96	2793,82	2801,89	2810,23	2818,80
60	2707,40	2717,30	2726,52	2735,17	2743,28	2750,93	2758,17	2765,40	2772,70	2780,26	2788,25	2796,45	2804,85	2813,65
65	2701,05	2710,96	2720,25	2728,98	2737,09	2744,86	2752,21	2759,47	2766,73	2774,43	2782,62	2790,81	2799,38	2808,31
70	2694,76	2704,64	2713,87	2722,75	2730,94	2738,73	2746,06	2753,41	2760,75	2768,45	2776,72	2785,06	2793,80	2802,88
75	2688,14	2698,07	2707,49	2716,35	2724,64	2732,39	2739,89	2747,23	2754,73	2762,58	2770,93	2779,26	2788,00	2797,21
80	2681,50	2691,50	2700,94	2709,76	2718,12	2726,06	2733,53	2740,93	2748,42	2756,43	2764,87	2773,33	2782,14	2791,52
85	2674,95	2684,98	2694,53	2703,33	2711,86	2719,74	2727,25	2734,80	2742,31	2750,22	2758,80	2767,44	2776,33	2785,81
90	2668,29	2678,49	2687,99	2696,91	2705,37	2713,32	2721,01	2728,59	2736,23	2744,24	2752,76	2761,51	2770,59	2780,11
95	2661,51	2671,82	2681,34	2690,33	2698,86	2706,88	2714,61	2722,23	2729,89	2737,98	2746,57	2755,34	2764,57	2774,25
100	2654,76	2664,99	2674,62	2683,63	2692,25	2700,33	2708,04	2715,73	2723,35	2731,55	2740,43	2749,28	2758,48	2768,43

Heat.	60 grains of ſpirit to 100 grains of water.	55 grains of ſpirit to 100 grains of water.	50 grains of ſpirit to 100 grains of water.	45 grains of ſpirit to 100 grains of water.	40 grains of ſpirit to 100 grains of water.	35 grains of ſpirit to 100 grains of water.	30 grains of ſpirit to 100 grains of water.	25 grains of ſpirit to 100 grains of water.	20 grains of ſpirit to 100 grains of water	15 grains of ſpirit to 100 grains of water.	10 grains of ſpirit to 100 grains of water.	5 grains of ſpirit to 100 grains of water.	Water.
deg.	Grains.	Grains	Grains.	Grains.	Grains.	Grains	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.
30	2852,03	2859,71	2867,12	2874,43	2881,34	2887,77	2894,22	2900,85	2908,21	2917,19	2928,80	2944,53	
35	2847,45	2855,32	2863,16	2870,87	2878,21	2885,06	2892,07	2899,31	2907,45	2916,95	2928,99	2945,02	2967,14
40	2842,62	2850,88	2859,06	2867,08	2874,81	2882,30	2889,78	2897,61	2906,39	2916,41	2928,93	2945,25	2967,45
45	2837,64	2846,16	2854,67	2863,04	2871,22	2879,22	2887,33	2895,67	2904,98	2915,55	2928,49	2945,20	2967,40
50	2832,76	2841,52	2850,29	2858,96	2867,52	2875,98	2884,57	2893,58	2903,39	2914,42	2927,81	2944,73	2967,05
55	2827,68	2836,69	2845,72	2854,75	2863,75	2872,67	2881,69	2891,11	2901,42	2913,02	2926,73	2943,98	2966,34
60	2822,65	2831,90	2841,10	2850,50	2859,87	2869,15	2878,72	2888,62	2899,35	2911,32	2925,50	2942,98	2965,39
65	2817,49	2826,90	2836,30	2845,97	2855,65	2865,45	2875,49	2885,85	2897,09	2909,43	2923,90	2941,69	2964,11
70	2812,16	2821,78	2831,61	2841,42	2851,53	2861,63	2872,06	2882,90	2894,56	2907,33	2922,24	2940,13	2962,66
75	2806,75	2816,63	2826,56	2836,80	2847,14	2857,70	2868,49	2879,67	2891,79	2905,04	2920,17	2938,33	2960,97
80	2801,25	2811,23	2821,38	2831,92	2842,56	2853,38	2864,54	2876,22	2888,73	2902,35	2917,83	2936,31	2959,07
85	2795,69	2805,85	2816,32	2827,12	2838,07	2849,28	2860,86	2872,88	2885,56	2899,55	2915,46	2934,14	2956,94
90	2790,13	2800,40	2811,05	2822,15	2833,38	2844,81	2856,80	2869,16	2882,25	2896,58	2912,84	2931,77	2954,70
95	2784,36	2794,91	2805,79	2817,08	2828,46	2840,26	2852,47	2865,15	2878,71	2898,44	2910,02	2929,15	2952,08
100	2778,64	2789,32	2800,25	2811,80	2823,55	2835,30	2848,18	2861,12	2875,07	2890,04	2906,97	2926,28	2949,34

TABLE II.—*Real specific Gravities at the different Temperatures.*

Heat.	The pure spirit.	100 grains of spirit to 5 grains of water.	100 grains of spirit to 10 grains of water.	100 grains of spirit to 15 grains of water.	100 grains of spirit to 20 grains of water.	100 grains of spirit to 25 grains of water.	100 grains of spirit to 30 grains of water.	100 grains of spirit to 35 grains of water.	100 grains of spirit to 40 grains of water.	100 grains of spirit to 45 grains of water.	100 grains of spirit to 50 grains of water.	100 grains of spirit to 55 grains of water.	100 grains of spirit to 60 grains of water.	100 grains of spirit to 65 grains of water.
deg.														
30	,83896	,84995	,85957	,86825	,87585	,88282	,88921	,89511	,90054	,90558	,91023	,91449	,91847	,92217
35	,83672	,84769	,85729	,86587	,87357	,88059	,88701	,89294	,89839	,90345	,90811	,91241	,91640	,92009
40	,83445	,84539	,85507	,86361	,87134	,87838	,88481	,89073	,89617	,90127	,90596	,91026	,91428	,91799
45	,83214	,84310	,85277	,86131	,86907	,87613	,88255	,88849	,89396	,89909	,90380	,90812	,91211	,91584
50	,82977	,84076	,85042	,85902	,86676	,87384	,88030	,88626	,89174	,89684	,90160	,90596	,90997	,91370
55	,82736	,83834	,84802	,85664	,86441	,87150	,87796	,88393	,88945	,89458	,89933	,90367	,90768	,91144
60	,82500	,83599	,84568	,85430	,86208	,86918	,87568	,88169	,88720	,89232	,89707	,90144	,90549	,90927
65	,82262	,83362	,84334	,85193	,85976	,86686	,87337	,87938	,88490	,89006	,89479	,89920	,90328	,90707
70	,82023	,83124	,84092	,84951	,85736	,86451	,87105	,87705	,88254	,88773	,89252	,89695	,90104	,90484
75	,81780	,82878	,83851	,84710	,85493	,86212	,86864	,87466	,88018	,88538	,89018	,89464	,89872	,90252
80	,81530	,82631	,83603	,84467	,85248	,85966	,86623	,87228	,87776	,88301	,88781	,89225	,89639	,90021
85	,81283	,82386	,83355	,84221	,85006	,85723	,86380	,86984	,87541	,88067	,88551	,88998	,89409	,89793
90	,81039	,82142	,83111	,83977	,84762	,85483	,86139	,86743	,87302	,87827	,88312	,88758	,89173	,89558
95	,80788	,81888	,82860	,83724	,84511	,85232	,85896	,86499	,87060	,87586	,88069	,88521	,88937	,89322
100	,80543	,81643	,82618	,83478	,84262	,84984	,85646	,86254	,86813	,87340	,87824	,88271	,88691	,89082

Heat.	100 grains of spirit to 70 grains of water.	100 grains of spirit to 75 grains of water.	100 grains of spirit to 80 grains of water.	100 grains of spirit to 85 grains of water.	100 grains of spirit to 90 grains of water	100 grains of spirit to 95 grains of water.	100 grains of spirit to 100 grains of water.	95 grains of spirit to 100 grains of water.	90 grains of spirit to 100 grains of water.	85 grains of spirit to 100 grains of water	80 grains of spirit to 100 grains of water.	75 grains of spirit to 100 grains of water.	70 grains of spirit to 100 grains of water.	65 grains of spirit to 100 grains of water.
deg.														
30	,92563	,92889	,93191	,93474	,93741	,93991	,94222	,94447	,94675	,94920	,95173	,95429	,95681	,95944
35	,92355	,92680	,92986	,93274	,93541	,93790	,94025	,94249	,94484	,94734	,94988	,95246	,95502	,95772
40	,92151	,92476	,92783	,93072	,93341	,93592	,93827	,94058	,94295	,94547	,94802	,95060	,95328	,95602
45	,91937	,92264	,92570	,92859	,93131	,93382	,93621	,93860	,94096	,94348	,94605	,94871	,95143	,95423
50	,91723	,92050	,92358	,92647	,92919	,93177	,93419	,93658	,93897	,94149	,94414	,94683	,94958	,95243
55	,91502	,91837	,92145	,92436	,92707	,92963	,93208	,93452	,93696	,93948	,94213	,94486	,94767	,95057
60	,91287	,91622	,91933	,92225	,92499	,92758	,93002	,93247	,93493	,93749	,94018	,94296	,94579	,94876
65	,91066	,91400	,91715	,92010	,92283	,92546	,92794	,93040	,93285	,93546	,93822	,94099	,94388	,94689
70	,90847	,91181	,91493	,91793	,92069	,92333	,92580	,92828	,93076	,93337	,93616	,93898	,94193	,94500
75	,90617	,90952	,91270	,91569	,91849	,92111	,92364	,92613	,92865	,93132	,93413	,93695	,93989	,94301
80	,90385	,90723	,91042	,91340	,91622	,91891	,92142	,92393	,92646	,92917	,93201	,93488	,93785	,94102
85	,90157	,90496	,90818	,91119	,91403	,91670	,91923	,92179	,92432	,92700	,92989	,93282	,93582	,93902
90	,89925	,90270	,90590	,90891	,91177	,91446	,91705	,91962	,92220	,92491	,92779	,93075	,93381	,93703
95	,89688	,90037	,90358	,90662	,90949	,91221	,91481	,91740	,91998	,92272	,92562	,92858	,93170	,93497
100	,89453	,89798	,90123	,90428	,90718	,90992	,91252	,91513	,91769	,92047	,92346	,92646	,92957	,93293

Heat.	60 grains of spirit to 100 grains of water.	55 grains of spirit to 100 grains of water.	50 grains of spirit to 100 grains of water.	45 grains of spirit to 100 grains of water.	40 grains of spirit to 100 grains of water.	35 grains of spirit to 100 grains of water.	30 grains of spirit to 100 grains of water.	25 grains of spirit to 100 grains of water.	20 grains of spirit to 100 grains of water.	15 grains of spirit to 100 grains of water.	10 grains of spirit to 100 grains of water.	5 grains of spirit to 100 grains of water.	Water.	
deg.														
30	,96209	,96470	,96719	,96967	,97200	,97418	,97635	,97860	,98108	,98412	,98804	,99334		
35	,96048	,96315	,96579	,96840	,97086	,97319	,97556	,97801	,98076	,98397	,98804	,99344	1,00090	
40	,95879	,96159	,96434	,96706	,96967	,97220	,97472	,97737	,98033	,98373	,98795	,99345	1,00094	
45	,95705	,95993	,96280	,96563	,96840	,97110	,97384	,97666	,97980	,98338	,98774	,99338	1,00086	
50	,95534	,95831	,96126	,96420	,96708	,96995	,97284	,97589	,97920	,98293	,98745	,99316	1,00068	
55	,95357	,95662	,95966	,96272	,96575	,96877	,97181	,97500	,97847	,98239	,98702	,99284	1,00038	
60	,95181	,95493	,95804	,96122	,96437	,96752	,97074	,97409	,97771	,98176	,98654	,99244	1,00000	
65	,95000	,95318	,95635	,95962	,96288	,96620	,96959	,97309	,97688	,98106	,98594	,99194	,99950	
70	,94813	,95139	,95469	,95802	,96143	,96484	,96836	,97203	,97596	,98028	,98527	,99134	,99894	
75	,94623	,94957	,95292	,95638	,95987	,96344	,96708	,97086	,97495	,97943	,98454	,99066	,99830	
80	,94431	,94768	,95111	,95467	,95826	,96192	,96568	,96963	,97385	,97845	,98367	,98991	,99759	
85	,94236	,94579	,94932	,95297	,95667	,96046	,96437	,96843	,97271	,97744	,98281	,98912	,99681	
90	,94042	,94389	,94748	,95123	,95502	,95889	,96293	,96711	,97153	,97637	,98185	,98824	,99598	
95	,93839	,94196	,94563	,94944	,95328	,95727	,96139	,96568	,97025	,97523	,98082	,98729	,99502	
100	,93638	,93999	,94368	,94759	,95152	,95556	,95983	,96424	,96895	,97401	,97969	,98625	,99402	

Spirituous Liquors.

We formerly obſerved, that the ſeries of mixtures choſen by Sir Charles Blagden, for the advantages attending it in making the experiment, was not ſuited for ſolving the queſtions which commonly occur in the ſpirit buſineſs. He accordingly ſuggeſts the propriety of forming tables in a convenient ſeries from the data furniſhed by theſe experiments, indicating the proportion of ingredients contained in ſome conſtant weight or bulk.

To facilitate the conſtruction of ſuch tables, it is neceſſary to conſider the ſubject in the moſt general manner. Therefore let *a* repreſent the conſtant number 100. Let *w* and *s* repreſent the quantities of water and ſpirit by weight in any mixture; that is, the pounds, ounces, or grains of each. Let *x* repreſent the quantity *per cent.* of ſpirits alſo by weight; that is, the number of pounds of ſpirits contained in 100 pounds of the mixture; and let *y* be its quantity *per cent.* in gallons, or the number of gallons contained in 100 gallons of the unmixed ingredients. Let *m* be the bulk of a pound of ſpirit of any given temperature, the bulk of a pound of water *of the ſame temperature* being accounted 1.

Then $w+s$ is the weight of any mixture, and $w+ms$ is its bulk.

We have the following proportions: 1. $w+s:s=a:x$, and $x=\frac{as}{w+s}$ (Equation 1ſt); and hence *s* may be found when *x* the per centage in weight is given, for $s=\frac{wx}{a-x}$ (Equation 2.)

2. $w+ms:ms=a:y$, and $y=a\frac{ms}{w+ms}$ (Equation 3d); and *s* may be found when *y*, the per centage in gallons, is given; for $s=\frac{my}{a-y}$ (Equation 4th.)

The uſual queſtions which can be ſolved from theſe experiments are,

1. To aſcertain the quantity of ſpirits *per cent.* in bulk from obſervation of the ſpecific gravity, or to tell how many gallons of ſpirit are in 100 gallons of mixture.

Look for the ſpecific gravity in the table, and at the head of the column will be found the *w* and *s* correſponding. If the preciſe ſpecific gravity obſerved is not in the tables, the *s* muſt be found by interpolation. And here it is proper to remark, that taking the ſimple proportional parts of ſpecific gravity will not be ſufficiently exact, eſpecially near the beginning or the end of the table, becauſe the denſities correſponding to the ſeries of mixtures do not change uniformly. We muſt have recourſe to the general rules of interpolation, by means of firſt and ſecond differences, or be provided with a ſubſidiary table of differences. A good deal of practice in computations of this kind ſuggeſted the following method of making ſuch interpolations with great diſpatch and abundant accuracy. On a plate of wood, or metal, or ſtiff card-paper, draw a line EF (fig. 3.), as a ſcale of equal parts, repreſenting the leading or equable arithmetical ſeries of any table. (In the preſent caſe EF is the ſcale on which *s* is computed.)—Through every point of diviſion draw the perpendiculars B A, E C, F D, &c. Make one of them AB more conſpicuous than the reſt, and diſtinguiſh the others alſo in ſuch ſort, that the eye ſhall readily catch their diſtance from the principal line A B. Let GPL be a thin ſlip of whalebone, of uniform breadth and thickneſs, alſo divided into equal parts properly diſtinguiſhable. Laſtly, let there be a pin P fixed near the middle of the principal line AB.

Plate CCCCLXXII.

Now ſuppoſe that a value of *s* is to be interpolated by means of an obſerved ſpecific gravity not in the table. Look for the neareſt to it, and note its diſtance from the preceding and the following. Let theſe be PH and PK on the flexible ſcale. Alſo take notice of the lines K 10 and H 10, whoſe diſtances from A B are equal to the conſtant difference between the ſucceſſive values of S, or to any eaſily eſtimated multiple of it (as in the preſent caſe we have taken 10 and 10, inſtead of 5 and 5, the running difference of Sir Charles Blagden's table). Then, leaning the middle point P of the whalebone on the pin P in the board, bend it, and place it ſlantwiſe till the points K and H fall ſomewhere on the two parallels K 10 and H 10. No matter how oblique the poſition of the whalebone is. It will bend in ſuch a manner that its different points of diviſion (repreſenting different ſpecific gravities) will fall on the parallels which repreſent the correſponding values of *s*. We can ſay that all this may be done in leſs than half a minute, and leſs time than is neceſſary for inſpecting a table of proportional parts, and not the tenth part of that neceſſary for interpolating by ſecond differences. Yet it is exact enough (if of the ſize of a duodecimo page) for interpolating three decimal places. This is ten times more exact than the preſent caſe requires. To return from this digreſſion.

Having thus found *s* in the table, we get *x* or *y* by the equations $\frac{as}{w+s}=x$, and $a\frac{ms}{w+ms}=y$.

But here a material circumſtance occurs. The weight of alcohol *s*, and its per centage *x*, was rightly determined by the ſpecific gravity, becauſe it was interpolated between two values, which were experimentally connected with this ſpecific gravity. But in making the tranſition from *x* to *y*, we only give the per centage in gallons before mixture, but not the number of gallons of alcohol contained in an hundred gallons of mixed liquor. For when we have taken $a-y$ and *y* inſtead of *w* and *s*, they will indeed make a ſimilar compound when mixed, becauſe the proportion of their ingredients is the ſame. But they will not make 100 gallons of this compound, becauſe there is a ſhrinking or condenſation by mixture, and the ſpecific gravity by which we interpolated *s* is the phyſical or real ſpecific gravity correſponding to *w* and *s*; while $\frac{w+s}{w\times ms}$, the ſpecific gravity implied in the value of *y*, is the mathematical denſity independent on this condenſation. Since therefore *y*, together with $a-y$, make leſs than 100 gallons of the compound, there muſt in 100 gallons of it be more alcohol than is expreſſed by *y*.

Let G be the mathematical ſpecific gravity $\left(=\frac{w+s}{w+ms}\right)$, and *g* the phyſical or real obſerved ſpecific gravity (which we cannot expreſs algebraically); and let *z* be the gallons of alcohol really contained in 100 gallons of the compound. The bulk being inverſely as the denſity or ſpecific gravity, it is evident that the

1. bulk

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bulk of the compound must be to 100 gallons as g to G. And since we want to make it still up to 100 gallons, we must increase it in the proportion of G to g. And because this augmentation must be of the same strength with this contracted liquor, both ingredients must be increased in the proportion of G to g, and we must have $G : g = y : z$, and $z = g \times \frac{y}{G}$. Now, instead of y, write $a \frac{ms}{w+ms}$, and instead of $\frac{1}{G}$ write $\frac{w+ms}{w+s}$, which are respectively equal to them. This gives us $z = ga \times \frac{w+ms}{w+s} \times \frac{ms}{w+s}, = ga \times \frac{ms}{w+s}$.

All this will be illustrated by an example.

Suppose that we have observed the specific gravity of a spirituous liquor of the temperature 60° to be 0,94128. Looking into Sir Charles Blagden's table, we find the gravities 0,94018 and 0,94296, and the s corresponding to them is 80 and 75, the water in each mixture being 100. By interpolation we obtain the s corresponding to 0,94128, *viz.* 78. At this temperature $m = \frac{1}{0,825}$, = 1,21212, and $ms = 94,54545$. Therefore $z = 0,94128 \times 100 \times \frac{94,54545}{194,54545}$, = 49,997, or very nearly 50.

We have seen even persons not unacquainted with subjects of this kind puzzled by this sort of paradox. z is said to be the per centage of spirit in the compound. The compound has the same proportion of ingredients when made up to 100 gallons as before, when y was said to be its per centage, and yet y and z are not the same. The fact is, that although z is the number of gallons of alcohol really contained in 100 gallons of the compound, and this alcohol is in the same proportion as before to the water, this proportion is not that of 50 to 50: for if the ingredients were separated again, there would be 50 gallons of alcohol and 52,876 of water.

The proportion of the ingredients in their separate state is had by the 3d Equation $y = a \frac{ms}{w+ms}$, which is equivalent to $G\, a \frac{ms}{w+s}$. For the present example y will be found 48,599, and $a - y$, or the water per cent. 51,401, making 100 gallons of unmixed ingredients. We see then that there has been added 1,398 gallons of alcohol; and since both ingredients are augmented in the proportion of G to g, there have also been added 1,478 of water, and the whole addition for making up the 100 gallons of compound is 2,876 gallons; and if the ingredients of the compound were separate, they would amount to 102,876 gallons. This might have been found at the first, by the proportion, $G : g - G = 100$: *(The addition.)*

The next question which usually occurs in business is to find what density will result from any proposed mixture *per* gallon. This question is solved by means of the equation $\frac{wy}{m(a-y)} = s$. In this examination it will be most convenient to make $w = a$. If the value of s found in this manner falls on a value in the tables, we have the specific gravity by inspection. If not, we must interpolate.

N. B. The value of m, which is employed in these reductions, varies with the temperature. It is always obtained by dividing the specific gravity of alcohol of that temperature by the specific gravity of water of the same temperature. The quotient is the real specific gravity of alcohol for that temperature. Both of these are to be had in the first and last copartments of Sir Charles Blagden's table.

These operations for particular cases give the answers to particular occasional questions. By applying them to all the numbers in the table, tables may be constructed for solving every question by inspection.

There is another question which occurs most frequently in the excise transactions, and also in all compositions of spirituous liquors, viz. What strength will result from a mixture of two compounds of known strength, or mixing any compound with water? To solve questions of this kind by the table so often quoted, we must add into one sum the water *per* gallon of the different liquors. In like manner, take the sum of the spirits, and say, as the sum of the waters is to that of the alcohols, so is a to s; and operate with a and s as before.

Analogous to this is the question of the duties. These are levied on proof spirit; that is, a certain duty is charged on a gallon of proof spirit; and the gauger's business is to discover how many gallons of proof spirit there is in any compound. The specification of proof spirit in our excise laws is exceedingly obscure and complex. A gallon weighing 7 pounds 13 ounces (at 55°) is accounted 1 to 6 under proof. The gallon of water contains 58476 grains, and this spirit is 54688. Its density therefore is 0,93523 at 55°, or (as may be inferred from the table) 0,9335 at 60°. This density corresponds to a mixture of 100 grains of water with 93,457 of alcohol. If this be supposed to result from the mixture of 6 gallons of alcohol with 1 of water (as is supposed by the designation of 1 to 6 under proof), the gallon of proof spirits consists of 100 parts of spirits by weight, mixed with 75 parts of water. Such a spirit will have the density 0,9162 nearly.

This being premised, in order to find the gallons of proof spirits in any mixture, find the quantity of alcohol by weight, and then say, as 100 to 175, so is the alcohol in the compound to the proof spirit that may be made of it, and for which the duties must be paid.

We have considered this subject at some length, because it is of great importance in the spirit-trade to have these circumstances ascertained with precision; and because the specific gravity is the only sure criterion that can be had of the strength. Firing of gunpowder, or producing a certain bubble by shaking, are very vague tests; whereas, by the specific gravity, we can very securely ascertain the strength within one part in 500, as will presently appear.

Sir Charles Blagden, or Mr Gilpin, have published * a most copious set of tables, calculated from these valuable experiments. In these, computations are made for every unit of the hundred, and for every degree of the thermometer. But these tables are still not in the most commodious form for business. Mr John Wilson, an ingenious gentleman residing at Dundee, has just published

* *Philosph. Trans.* 1794.

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liſhed at Edinburgh tables ſomewhat ſimilar, founded on the ſame experiments. Both of theſe tables ſhow the quantities by meaſure correſponding to every unit by weight of Sir Charles Blagden's experiments, and for every degree of temperature. They alſo ſhow the *per centage* of alcohol, and the condenſation or the quantity loſt by mixture. But as they both retain the original ſeries of parts by weight, which is very unuſual, the ſpirit traders will find conſiderable difficulty in making uſe of them. Retaining this ſeries alſo cauſes all the *per centage* numbers (which are the only intereſting ones to the trader) to be fractional, and no anſwer can be had without a double interpolation.

We have therefore calculated a table in the form in which it muſt be moſt uſeful and acceptable to thoſe who are engaged in the ſpirit trade, ſhowing at once the ſpecific gravity which reſults from any proportion of admixture in hundredth parts of the whole. This anſwers immediately the chief queſtions in the terms in which they are uſually conceived and propoſed. The two firſt or leading columns ſhow the proportion in gallons, pints, or other cubic meaſures, of the mixture, the whole quantity being always 100. The ſecond column ſhows the correſponding ſpecific gravity: ſo that we can either find the proportion of the ingredients by the obſerved ſpecific gravity, or find the grav ty reſulting from any proportion of the ingredients. A third column ſhows how much the hundred meaſures of the two ingredients fall ſhort of making an hundred meaſures of the compound. A ſimple proportion, which can be done without the pen, will determine what part of this deficiency muſt be made up by ſpirit. The uſe of this table muſt now be ſo familiar to the reader's mind, that we need not give further inſtructions about it.

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This is followed by another ſimilar table, giving an immediate anſwer to the moſt uſual queſtion, "How many meaſures of alcohol are there really contained in 100 meaſures? This is alſo accompanied by a column of condenſation. It would have been ſomewhat more elegant, had the ſpecific gravities in this table made the equable ſeries and leading column. But we did not advert to this till we had computed the table, and the labour was too great to be repeated for ſlight reaſons. The tables are only for the temperature 60°. To this the ſpirituous liquors can always be brought in theſe climates; and in caſes where we cannot, a moment's inſpection of Sir Charles Blagden's table will point out very nearly (or exactly, by a ſhort computation) the neceſſary corrections.

Compound. S.	Compound. W.	Specific Gravity.	Cond. *per cent.*	Compound. S.	Compound. W.	Specific Gravity.	Cond. *per cent.*	Compound. S.	Compound. W.	Specific Gravity.	Cond. *per cent.*
100	0	0,8250		66	34	0,9073	2,5	33	67	0,9640	2,3
99	1	0,8278	0,19	65	35	0,9095	2,6	32	68	0,9651	2,3
98	2	0,8306	0,33	64	36	0,9116	2,6	31	69	0,9662	2,2
97	3	0,8333	0,4	63	37	0,9137	2,6	30	70	0,9673	2,1
96	4	0,8360	0,5	62	38	0,9157	2,6	29	71	0,9683	2,
95	5	0,8387	0,6	61	39	0,9177	2,7	28	72	0,9693	1,9
94	6	0,8413	0,7	60	40	0,9198	2,7	27	73	0,9704	1,9
93	7	0,8439	0,8	59	41	0,9218	2,7	26	74	0,9713	1,8
92	8	0,8465	0,9	58	42	0,9238	2,7	25	75	0,9724	1,7
91	9	0,8491	1,	57	43	0,9257	2,7	24	76	0,9734	1,6
90	10	0,8516	1,1	56	44	0,9277	2,8	23	77	0,9744	1,6
89	11	0,8542	1,2	55	45	0,9296	2,8	22	78	0,9754	1,5
88	12	0,8567	1,3	54	46	0,9316	2,8	21	79	0,9763	1,4
87	13	0,8592	1,4	53	47	0,9335	2,8	20	80	0,9773	1,3
86	14	0,8617	1,5	52	48	0,9353	2,8	19	81	0,9783	1,2
85	15	0,8641	1,5	51	49	0,9371	2,8	18	82	0,9793	1,2
84	16	0,8666	1,6	50	50	0,9388	2,8	17	83	0,9802	1,1
83	17	0,8690	1,7	49	51	0,9406	2,8	16	84	0,9812	1,
82	18	0,8713	1,7	48	52	0,9423	2,8	15	85	0,9822	0,9
81	19	0,8737	1,7	47	53	0,9440	2,8	14	86	0,9832	0,9
80	20	0,8760	1,8	46	54	0,9456	2,7	13	87	0,9842	0,8
79	21	0,8764	1,9	45	55	0,9473	2,7	12	88	0 9853	0,7
78	22	0,8807	2,	44	56	0,9489	2,7	11	89	0,9863	0,7
77	23	0,8830	2,	43	57	0,9505	2,7	10	90	0,9874	0,6
76	24	0,8853	2,1	42	58	0,9520	2,7	9	91	0,9886	0,5
75	25	0,8876	2,1	41	59	0,9535	2,6	8	92	0,9897	0,4
74	26	0,8899	2,2	40	60	0,9549	2,6	7	93	0,9909	0,3
73	27	0,8921	2,2	39	61	0,9563	2,6	6	94	0,9921	0,3
72	28	0,8944	2,3	38	62	0,9577	2,5	5	95	0,9933	0,2
71	29	0,8966	2,3	37	63	0,9590	2,5	4	96	0,9946	0,1
70	30	0,8988	2,4	36	64	0,6603	2,4	3	97	0,9959	0,07
69	31	0,9010	2,5	35	65	0,9616	2,4	2	98	0,9972	0,03
68	32	0,9031	2,5	34	66	0,9628	2,3	1	99	0,9985	0,01
67	33	0,9053	2,5	33	67	0,9640	2,3	0	100	1,0000	0,00
66	34	0,9073	2,5								

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Spir. *per cent.*	Specific Gravity.	Contr.	Spir. *per cent.*	Specific Gravity.	Contr.	Spir. *per cent.*	Specific Gravity.	Contr.
100	0,82500		66	0,91095	2,59	33	0,96481	2,27
99	0,82629	0,18	65	0,91306	2,62	32	0,96587	2,21
98	0,83142	0,34	64	0,91511	2,64	31	0,96691	2,15
97	0,83449	0,46	63	0,91714	2,66	30	0,96793	2,08
96	0,83750	0,57	62	0,91914	2,68	29	0,96894	2,00
95	0,84048	0,68	61	0,92112	2,70	28	0,96992	1,93
94	0,84339	0,8	60	0,92308	2,72	27	0,97089	1,86
93	0,84621	0,9	59	0,92501	2,74	26	0,97185	1,79
92	0,84900	1,01	58	0,92692	2,76	25	0,97280	1,71
91	0,85172	1,11	57	0,92883	2,77	24	0,97374	1,63
90	0,85443	1,21	56	0,93072	2,78	23	0,97468	1,56
89	0,85704	1,31	55	0,93258	2,80	22	0,97561	1,48
88	0,85971	1,39	54	0,93436	2,81	21	0,97654	1,4
87	0,86228	1,47	53	0,93612	2,81	20	0,97747	1,32
86	0,86483	1,54	52	0,93786	2,82	19	0,97841	1,24
85	0,86737	1,61	51	0,93958	2,81	18	0,97936	1,17
84	0,86987	1,67	50	0,94128	2,79	17	0,98032	1,08
83	0,87235	1,74	49	0,94293	2,78	16	0,98129	1,00
82	0,87481	1,81	48	0,94455	2,76	15	0,98228	,93
81	0,87726	1,88	47	0,94610	2,73	14	0,98328	,85
80	0,87969	1,94	46	0,94768	2,71	13	0,98430	,78
79	0,88207	2,	45	0,94923	2,70	12	0,98534	,71
78	0,88445	2,05	44	0,95074	2,68	11	0,98640	,66
77	0,88676	2,11	43	0,95219	2,66	10	0,98748	,61
76	0,88909	2,17	42	0,95364	2,63	9	0,98858	,51
75	0,89140	2,22	41	0,95502	2,60	8	0,98973	,43
74	0,89367	2,26	40	0,95636	2,58	7	0,99091	,34
73	0,89593	2,31	39	0,95766	2,54	6	0,99211	,25
72	0,89815	2,36	38	0,95894	2,49	5	0,99334	,18
71	0,90035	2,41	37	0,96019	2,46	4	0,99461	,12
70	0,90241	2,49	36	0,96141	2,43	3	0,99591	,7
69	0,90464	2,47	35	0,96258	2,38	2	0,99725	,3
68	0,90675	2,51	34	0,96371	2,33	1	0,99861	,1
67	0,90885	2,55	33	0,96481	2,27	0	1,00000	,0
66	0,91095	2,59						

" In the firſt table, of which the ſole intention is to point out the proportion of ingredients, the ſpecific gravities are computed only to four places, which will always give the anſwer true to $\frac{1}{8000}$th part. In the laſt, which is more immediately intereſting to the merchant in his tranſactions with the exciſe office, the computation is carried one place further."

The conſideration of the firſt of theſe two tables will furniſh ſome uſeful information to the reader who is intereſted in the philoſophy of chemical mixture, and who endeavours to inveſtigate the nature of thoſe forces which connect the particles of tangible matter. Theſe vary with the diſtance of the particle; and therefore the law of their action, like that of univerſal gravitation, is to be diſcovered by meaſuring their ſenſible effects at their various diſtances. Their change of diſtance is ſeen in the change of denſity or ſpecific gravity.

Did the individual denſities of the water and ſpirit remain unchanged by mixture, the ſpecific gravity would change by equal differences in the ſeries of mixtures on which this table is conſtructed; for the bulk being always the ſame, the change of ſpecific gravity muſt be the difference between the weight of the gallon of water which is added and that of the gallon of ſpirit which is taken out. The whole difference of the ſpecific gravities of ſpirits and water being 1,750 parts in 10,000, the augmentation by each ſucceſſive change of a meaſure of ſpirit for a meaſure of water would be the 100th part of this, or 17,5. But, by taking the ſucceſſive differences of denſity as they occur in the table, we ſee that they are vaſtly greater in the firſt additions of water, being then about 29; after which they gradually diminiſh to the medium quantity $17\frac{1}{2}$, when water and ſpirits are mixed in nearly equal bulks. The differences of ſpecific gravity ſtill diminiſh, and are reduced to 9, when about 75 parts of water are mixed with 25 of ſpirit. The differences now increaſe again; and the laſt, when 99 parts of water are mixed with 1 part of ſpirit, the difference from the ſpecific gravity of pure water is above 14.

The mechanical effect, therefore, of the addition of a meaſure of water to a great quantity of ſpirit is greater than the ſimilar effect of the addition of a meaſure of ſpirits to a great quantity of water. What we call mechanical effect is the local motion, the change of diſtance of the particles, that the corpuſcular forces may again be in equilibrio. Obſerve, too, that this change is greater than in the proportion of the diſtance of the

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particles; for the denſity of water is to that of ſpirits nearly as 6 to 5, and the changes of ſpecific gravity are nearly as 6 to 3.

We alſo ſee that the changing cauſe, which produces the abſolute condenſation of each ingredient, ceaſes to operate when 75 parts of water have been mixed with 25 of alcohol: for the variation of ſpecific gravity, from diminiſhing comes now to increaſe; and therefore, in this particular ſtate of compoſition, is equable. Things are now in the ſame ſtate as if we were mixing two fluids which did not act on each other, but were mutually diſſeminated, and whoſe ſpecific gravities are nearly as 9 to 10; for the variation 9 of ſpecific gravity may be conſidered as the 100th part of the whole difference, in the ſame manner as 17,5 would have been had water and alcohol ſuſtained no contraction.

The imagination is greatly aſſiſted in the contemplation of geometrical quantity by exhibiting it in its own form. Specific gravity, being an expreſſion of denſity (a notion purely geometrical), admits of this illuſtration.

Plate CCCCLXXII.

Therefore let AB (fig. 4.) repreſent the bulk of any mixture of water and alcohol. The ſpecific gravity of water may be repreſented by a line of ſuch a length, that AB ſhall be the difference between the gravities of alcohol and water. Suppoſe it extended upwards, towards *a*, till B*a* is to A*a* as 10,000 to 8250. It will ſuit our purpoſe better to repreſent it by a parallelogram *a* BF*e*, of any breadth BF. In this caſe the difference of the ſpecific gravities of alcohol and water will be expreſſed by the parallelogram ABFE. If there were no change produced in the denſity of one or both ingredients, the ſpecific gravity of the compound would increaſe as this parallelogram does, and AGHE would be the augmentation correſponding to the mixture of the quantity AG of alcohol with the quantity GB of water, and ſo of other mixtures. But, to expreſs the augmentation of denſity as it really obtains, we muſt do it by ſome curvilineal area DABCHD, which varies at the rate determined by Sir Charles Blagden's experiments. This area muſt be preciſely equal to the rectangle ABFE. It muſt therefore fall without it in ſome places, and be deficient in others. Let DMHKC be the curve which correſponds with theſe experiments. It is evident to the mathematical reader, that the ordinates LM, GH, IK, &c. of this curve are in the ultimate ratio of the differences of the obſerved ſpecific gravities. If Aα, $\alpha\beta$, &c. are each $=5$, the little ſpaces A$\alpha\delta$D, $\alpha\beta b\delta$, &c. will be preciſely equal to the differences of the ſpecific gravities 0,8250; 0,8387; 0,8516; &c. correſponding to the different mixtures of water and alcohol. The curve cuts the ſide of the parallelogram in K, where the ordinate GK expreſſes the mean variation of denſity 0,0017,5. IK is the ſmalleſt variation. The condenſation may be expreſſed by drawing a curve *dmGkf* parallel to DMGKF, making D*d* = AE. The condenſation is now repreſented by the ſpaces comprehended between this laſt curve and the abſciſſa AGB, reckoning thoſe negative which lie on the other ſide of it. This ſhows us, not only that the condenſation is greateſt in the mixture AG×GB, but alſo that in mixing ſuch a compound with another AI×IB, there is a rarefaction. Another curve ANPOB may be drawn, of which the ordinates LN, GP, IO, &c. are proportional to the areas AL*md*, AG*m*D, AI*k*G*m*D (=AG*md*—GI*k*), &c. This curve ſhows the whole condenſation.

Spirituous Liquors || Splachnum.

This manner of repreſenting the ſpecific gravities of mixtures will ſuggeſt many curious inferences to ſuch as will conſider them in the manner of Boſcovich, with a view to aſcertain the nature of the forces of coheſion and chemical affinities: And this manner of viewing the ſubject becomes every day more promiſing, in conſequence of our improvements in chemical knowledge; for we now ſee, that mechaniſm, or motive forces, are the cauſes of chemical action. We ſee in almoſt every caſe, that chemical affinities are comparable with mechanical preſſures; becauſe the converſion of a liquid into a vapour or gas is prevented by atmoſpheric preſſure, and produced by the great chemical agent heat. The action of heat, therefore, or of the cauſe of heat, is a mechanical action, and the forces are common mechanical forces, with which we are familiarly acquainted.

"It may be alſo remarked in the column of contractions, that in the beginning the contractions augment nearly in the proportion of the quantity of ſpirits (but more ſlowly); whereas, in the end, the contractions are nearly in the duplicate proportion of the quantity of water. This circumſtance deſerves the conſideration of the philoſopher. We have repreſented it to the eye by the curve *α g b d*."

We ſhould here take ſome notice of the attempt made to elude ſome part of the duties, by adding ſome ingredient to the ſpirits. But our information on this ſubject is not very exact; and beſides it would be doing no ſervice to the trader to put fraud more in his power. There are ſome ſalts which make a very great augmentation of denſity, but they render the liquor unpalatable. Sugar is frequently uſed with this view; 16 grains of refined ſugar diſſolved in 1000 grains of proof ſpirits gave it no ſuſpicious taſte, and increaſed its ſpecific gravity from 0,920 to 0,925, which is a very great change, equivalent to the addition of 9 grains of water to a mixture of 100 grains of alcohol and 80 of water.

SPITHEAD, a road between Portſmouth and the Iſle of Wight, where the royal navy of Great Britain frequently rendezvous.

SPITTLE, in phyſiology. See SALIVA.

SPITZBERGEN. See GREENLAND, n° 10.

SPLACHNUM, in botany: A genus of plants belonging to the claſs of *cryptogamia*, and order of *muſci*. The antheræ are cylindrical, and grow on a large coloured apophyſis or umbraculum. The calyptra is caducous. The female ſtar grows on a ſeparate ſtem. There are ſix ſpecies, the rubrum, luteum, ſphæricum, ampullaceum, vaſculoſum, anguſtatum. Two of theſe are natives of Britain.

1. The *ampullaceum*, or crewet ſplachnum, is found in bogs and marſhes, and often upon cow-dung. It grows in thick tufts, and is about two inches high. The leaves are oval lanceolate, terminated with a long point or beard. The top of the filament or peduncle ſwells into the form of an inverted cone, which Linnæus terms an *apophyſis* or *umbraculum*; upon the top of which is placed a cylindrical anthera, like the neck of a crewet. The calyptra is conical, and reſembles a ſmall extinguiſher.

2. The *vaſculoſum*, or acorn-ſhaped ſplachnum, is found upon bogs and cow-dung, and upon the points of

Spleen || Spoliation.

rocks on the top of the Highland mountains, as on Ben-Lomond, and in the Isle of Sky, and elsewhere. This differs little from the preceding, and perhaps is no more than a variety. The filaments are about an inch high. The leaves oval-acute, not so lanceolate and bearded as the other. The apophysis, and the anthera at the top of it, form together nearly an oval figure, not unlike an acorn in its cup, the apophysis being transversely semi-oval, and of a blood-red colour, the anthera short and conical. The calyptra is the same as that of the other. The operculum is short and obtuse, and the rim of the anthera has eight large horizontal cilia. The anthera of the other is also ciliated, but not so distinctly. It is an elegant moss, and very distinguishable on account of its orange-coloured filaments and dark-red capsules.

SPLEEN, in anatomy. See ANATOMY, n° 99.

Spleen-Wort. See ASPLENIUM.

SPLENETIC, a person afflicted with an obstruction of the spleen.

SPLENT, or SPLINT, among farriers, a callous insensible excrescence, breeding on the shank-bone of horses. See FARRIERY, Sect. xxxi.

SPLICING, in the sea-language, is the untwisting the ends of two cables or ropes, and working the several strands into one another by a fidd, so that they become as strong as if they were but one rope.

SPOILS, whatever is taken from the enemy in time of war. Among the ancient Greeks, the spoils were divided among the whole army; only the general's share was largest: but among the Romans, the spoils belonged to the republic.

SPOLETTO, a duchy of Italy, bounded on the north by the Marquisate of Ancona and duchy of Urbino, on the east by Farther Abruzzo, on the south by Sabina and the patrimony of St Peter, and on the west by Orvietano and Perugino. It is about 55 miles in length and 40 in breadth. It was anciently a part of Umbria, and now belongs to the Pope.—The name of the capital city is also *Spoletto*. It was formerly a large place, but in 1703 was ruined by an earthquake; from whence it has never recovered itself.

SPOLIATION, in ecclesiastical law, is an injury done by one clerk or incumbent to another, in taking the fruits of his benefice without any right thereunto, but under a pretended title. It is remedied by a decree to account for the profits so taken. This injury, when the *jus patronatus*, or right of advowson, doth not come in debate, is cognizable in the spiritual court: as if a patron first presents A to a benefice, who is instituted and inducted thereto; and then, upon pretence of a vacancy, the same patron presents B to the same living, and he also obtains institution and induction. Now if A disputes the fact of the vacancy, then that clerk who is kept out of the profits of the living, whichever it be, may sue the other in the spiritual court for spoliation, or taking the profits of his benefice. And it shall there be tried, whether the living were or were not vacant; upon which the validity of the second clerk's pretensions must depend. But if the right of patronage comes at all into dispute, as if one patron presented A, and another patron presented B, there the ecclesiastical court hath no cognizance, provided the tithes sued for amount to a fourth part of the value of the living, but may be prohibited at the instance of the patron by the king's writ of *indicavit*. So also if a clerk, without any colour of title, ejects another from his parsonage, this injury must be redressed in the temporal courts: for it depends upon no question determinable by the spiritual law (as plurality of benefices or no plurality, vacancy or no vacancy), but is merely a civil injury.

Spondee || Spongia.

SPONDEE, in ancient poetry, a foot consisting of two long syllables, as *omnes*.

SPONDIAS, BRASILIAN or JAMAICA PLUM, in botany; a genus of plants belonging to the class of *decandria*, and order of *pentogynia*. The calyx is quinquedentate. The corolla pentapetalous. The fruit contains a quinquelocular kernel. There are only two species, the mombin and myrobalanus, which appear so much confounded in the descriptions of different botanists, that we do not venture to present them to our readers.

SPONGIA, SPONGE, in natural history; a genus of animals belonging to the class of *vermes*, and order of *zoophyta*. It is fixed, flexible, and very torpid, growing in a variety of forms, composed either of reticulated fibres, or masses of small spines interwoven together, and clothed with a living gelatinous flesh, full of small mouths or holes on its surface, by which it sucks in and throws out the water. Fifty species have already been discovered, of which 10 belong to the British coasts.

1. *Oculata*, or branched sponge, is delicately soft and very much branched; the branches are a little compressed, grow erect, and often united together. They have rows of cells on each margin, that project a little. This species is of a pale yellow colour, from five to ten inches high. The fibres are reticulated, and the flesh or gelatinous part is so tender, that when it is taken out of the water it soon dries away. It is very common round the sea-coast of Britain and Ireland. This description will be better understood by Plate CCCCLXXV. fig. 1. At *b*, *b*, along the edges and on the surface of the branches, are rows of small papillary holes, through which the animal receives its nourishment.

2. *Crista*, or cock's comb sponge, is flat, erect, and soft, growing in the shape of cock's combs, with rows of little holes along the tops, which project a little. It abounds on the rocks to the eastward of Hastings in Sussex, where it may be seen at low-water. It is commonly about three inches long, and two inches high, and of a pale yellowish colour. When put into a glass vessel of sea-water, it has been observed to suck in and squirt out the water through little mouths along the tops, giving evident signs of life.

3. *Stuposa*, tow-sponge, or downy branched sponge, is soft like tow, with round branches, and covered with fine pointed hairs. It is of a pale yellow colour, and about three inches high. It is frequently thrown on the shore at Hastings in Sussex. Fig. 2. represents this sponge; but it is so closely covered with a fine down, that the numerous small holes in its surface are not discernible.

4. *Dichotoma*, dichotomous or forked sponge, is stiff, branched, with round, upright, elastic branches, covered with minute hairs. It is found on the coast of Norway, and also, according to Berkenhout, on the Cornish and Yorkshire coasts. It is of a pale yellow colour, and full of very minute pores, guarded by minute spines. Fig. 3.

5.

Fig. 4.

Fig. 2.

Fig. 1.

Fig. 3.

A. Bell Print. Wat. Sculptor fecit.

Spongia.

5. *Urens* or *tomentoſa*, ſtinging ſponge, or crumb of bread ſponge, is of many forms, full of pores, very brittle and ſoft, and interwoven with very minute ſpines. It is full of ſmall protuberances, with a hole in each, by which it ſucks in and throws out the water. It is very common on the Britiſh coaſt, and is frequently ſeen ſurrounding fucuſes. It is found alſo on the ſhores of North America, Africa, and in the Eaſt Indies. When newly taken out of the ſea, it is of a bright orange colour, and full of gelatinous fleſh; but when dry, it becomes whitiſh, and when broken has the appearance of crumb of bread. If rubbed on the hand, it will raiſe bliſters; and if dried in an oven, its power of ſtinging is much increaſed, eſpecially that variety of it which is found on the ſea-coaſt of North America.

6. *Palmata*, palmated ſponge, is like a hand with fingers a little divided at the top. The mouths are a little prominent, and irregularly diſpoſed on the ſurface. It is found on the beach at Brighthelmſtone. It is of a reddiſh colour, inclining to yellow, and of the ſame ſoft woolly texture with the ſpongia oculata, fig. 4.

7. *Coronata*, coronet ſponge, is very ſmall, conſiſting of a ſingle tube ſurrounded at top by a crown of little ſpines. The tube is open at the top. The rays that compoſe the little crown are of a bright, ſhining pearl colour; the body is of a pale yellow. It has been found in the harbour of Emſworth, between Suſſex and Hampſhire.

8. *Botryoides*, grape ſponge, is very tender and branched, as if in bunches: the bunches are hollow, and are made up of oblong oval figures having the appearance of grapes; and each bunch is open at top. This ſpecies is of a bright, ſhining colour. The openings at the top are evidently the mouths by which the animal imbibes and diſcharges moiſture. When the ſurface is very much magnified, it appears covered with little maſſes of triple, equidiſtant, ſhining ſpines.

9. *Lacuſtris*, creeping ſponge, has erect, cylindrical, and obtuſe branches. It is found in lakes in Sweden and England.

10. *Fluviatilis*, river ſponge, is green, erect, brittle, and irregularly diſpoſed in numerous branches. It abounds in many parts of Europe, in the freſh rivers of Ruſſia and England, but particularly in the river Thames. It ſcarcely exhibits any ſymptoms of life, is of a fiſhy ſmell: its pores or mouths are ſometimes filled with green gelatinous globules. It differs very little from the lacuſtris.

So early as the days of Ariſtotle ſponges were ſuppoſed to poſſeſs animal life; the perſons employed in collecting them having obſerved them ſhrink when torn from the rocks, thus exhibiting ſymptoms of ſenſation. The ſame opinion prevailed in the time of Pliny: But no attention was paid to this ſubject till Count Marſigli examined them, and declared them vegetables. Dr Peyſonell, in a paper which he ſent to the Royal Society in the year 1752, and in a ſecond in 1757, affirmed they were not vegetables, but the production of animals; and has accordingly deſcribed the animals, and the proceſs which they performed in making the ſponges. Mr Ellis, in the year 1762, was at great pains to diſcover theſe animals. For this purpoſe he diſſected the ſpongia urens, and was ſurpriſed to find a great number of ſmall worms of the genus of nereis or ſea-ſcolopendra, which had pierced their way through the ſoft ſubſtance of the ſponge in queſt of a ſafe retreat. That this was really the caſe, he was fully aſſured of, by inſpecting a number of ſpecimens of the ſame ſort of ſponge, juſt freſh from the ſea. He put them into a glaſs filled with ſea-water; and then, inſtead of ſeeing any of the little animals which Dr Peyſonell deſcribed, he obſerved the papillæ or ſmall holes with which the papillæ are ſurrounded contract and dilate themſelves. He examined another variety of the ſame ſpecies of ſponge, and plainly perceived the ſmall tubes inſpire and expire the water. He therefore concluded, that the ſponge is an animal, and that the ends or openings of the branched tubes are the mouths by which it receives its nouriſhment, and diſcharges its excrements.

Sponſor ‖ Spotſwood.

SPONSORS, among Chriſtians, are thoſe perſons who, in the office of baptiſm, anſwer or are ſureties for the perſons baptized.

SPONTANEOUS, a term applied to ſuch motions of the body and operations of the mind as we perform of ourſelves without any conſtraint.

SPOON-BILL, in ornithology. See PLATALEA.

SPOONING, in the ſea-language, is ſaid of a ſhip, which being under ſail in a ſtorm at ſea, is unable to bear it, and conſequently forced to go right before the wind.

SPORADES, among ancient aſtronomers, a name given to ſuch ſtars as were not included in any conſtellation.

SPORADIC DISEASES, among phyſicians, are ſuch as ſeize particular perſons at any time or ſeaſon, and in any place; in which ſenſe they are diſtinguiſhed from epidemical and endemical diſeaſes.

SPOTS, in aſtronomy, certain places of the ſun's or moon's diſk, obſerved to be either more bright or dark than the reſt; and accordingly called *faculæ & maculæ*. See ASTRONOMY-*Index*.

SPOTSWOOD (John), archbiſhop of St Andrew's in Scotland, was deſcended from the lairds of Spotſwood in the Merſe, and was born in the year 1565. He was educated in the univerſity of Glaſgow, and ſucceeded his father in the parſonage of Calder when but 18 years of age. In 1601 he attended Lodowick duke of Lennox as his chaplain, in an embaſſy to the court of France for confirming the ancient amity between the two nations, and returned in the ambaſſador's retinue through England. When he entered into the archbiſhopric of Glaſgow, he found there was not 100l. Sterling of yearly revenue left; yet ſuch was his care for his ſucceſſors, that he greatly improved it, and much to the ſatisfaction of his dioceſe. After having filled this ſee 11 years, he was raiſed to that of St Andrew's in 1615, and made primate and metropolitan of all Scotland. He preſided in ſeveral aſſemblies for reſtoring the ancient diſcipline, and bringing the church of Scotland to ſome ſort of uniformity with that of England. He continued in high eſteem with king James I. nor was he leſs valued by king Charles I. who was crowned by him in 1633, in the abbey-church of Holyroodhouſe. In 1635, upon the death of the earl of Kinnoul chancellor of Scotland, our primate was advanced to that poſt; but had ſcarcely held it four years, when the confuſions beginning in Scotland, he was obliged to retire into England; and being broken with age, grief, and ſickneſs, died at London in 1639.

Spout || Spring.

1639, and was interred in Weſtminſter-abbey. He wrote A Hiſtory of the Church of Scotland from the year 203 to the reign of king James VI. in folio.

SPOUT, or *Water-Spout*. See *Water-Spout*.

Spout-*Fiſh*. See Solen.

SPRAT (Dr Thomas), biſhop of Rocheſter, was born in 1636. He had his education at Oxford, and after the Reſtoration entered into holy orders. He became fellow of the Royal Society, chaplain to George duke of Buckingham, and chaplain in ordinary to king Charles II. In 1667 he publiſhed the Hiſtory of the Royal Society, and a Life of Mr Cowley; who, by his laſt will, left to his care his printed works and MSS. which were accordingly publiſhed by him. In 1668 he was inſtalled prebendary of Weſtminſter; in 1680, was appointed canon of Windſor; in 1683, dean of Weſtminſter; and in 1684, conſecrated to the biſhopric of Rocheſter. He was clerk of the cloſet to king James II.; in 1685, was made dean of the chapel royal; and the year following, was appointed one of the commiſſioners for eccleſiaſtical affairs. In 1692 his lordſhip, with ſeveral other perſons, was charged with treaſon by two men, who drew up an aſſociation, in which they whoſe names were ſubſcribed declared their reſolution to reſtore king James; to ſeize the princeſs of Orange, dead or alive; and to be ready with 30,000 men to meet king James when he ſhould land. To this they put the names of Sancroft, Sprat, Marlborough, Saliſbury, and others. The biſhop was arreſted, and kept at a meſſenger's, under a ſtrict guard, for eleven days. His houſe was ſearched, and his papers ſeized, among which nothing was found of a treaſonable appearance, except one memorandum, in the following words: *Thorough-paced doctrine*. Being aſked at his examination the meaning of the words, he ſaid that, about 20 years before, curioſity had led him to hear Daniel Burgeſs preach; and that being ſtruck with his account of a certain kind of doctrine, which he ſaid *entered at one ear, and pacing through the head went out at the other*, he had inſerted the memorandum in his table-book, that he might not loſe the ſubſtance of ſo ſtrange a ſermon. His innocence being proved, he was ſet at liberty, when he publiſhed an account of his examination and deliverance; which made ſuch an impreſſion upon him, that he commemorated it through life by an yearly day of thankſgiving. He lived to the 79th year of his age, and died May 20. 1713. His works, beſides a few poems of little value, are, "The Hiſtory of the Royal Society;" "The Life of Cowley;" "The Anſwer to Sorbiere;" "The Hiſtory of the Rye-houſe Plot;" "The Relation of his own Examination;" and a volume of "Sermons." Dr Johnſon ſays, "I have heard it obſerved, with great juſtneſs, that every book is of a different kind, and that each has its diſtinct and characteriſtical excellence."

Sprat, in ichthyology. See Clupea.

SPRAY, the ſprinkling of the ſea, which is driven from the top of a wave in ſtormy weather. It differs from ſpoon-driſt, as being only blown occaſionally from the broken ſurface of a high wave; whereas the latter continues to fly horizontally along the ſea, without intermiſſion, during the exceſs of a tempeſt or hurricane.

SPRING, in natural hiſtory, a fountain or ſource of water riſing out of the ground.

Many have been the conjectures of philoſophers concerning the origin of fountains, and great pains have been taken both by the members of the Royal Society and thoſe of the Academy of Sciences at Paris, in order to aſcertain the true cauſe of it. It was Ariſtotle's opinion, and held by moſt of the ancient philoſophers after him, that the air contained in the caverns of the earth, being condenſed by cold near its ſurface, was thereby changed into water; and that it made its way through, where it could find a paſſage. But we have no experience of any ſuch tranſmutation of air into water. Spring.

Thoſe who imagine that fountains owe their origin to waters brought from the ſea by ſubterraneous ducts, give a tolerable account how they loſe their ſaltneſs by percolation as they paſs through the earth: but they find great difficulty in explaining by what power the water riſes above the level of the ſea to near the tops of mountains, where ſprings generally abound; it being contrary to the laws of hydroſtatics, that a fluid ſhould riſe in a tube above the level of its ſource. However, they have found two ways whereby they endeavour to extricate themſelves from this difficulty. The one is that of Des Cartes, who imagines, that after the water is become freſh by percolation, it is raiſed out of the caverns of the earth in vapour towards its ſurface; where meeting with rocks near the tops of mountains in the form of arches or vaults, it ſticks to them, and runs down their ſides, (like water in an alembic), till it meets with proper receptacles, from which it ſupplies the fountains. Now this is a mere hypotheſis, without foundation or probability: for, in the firſt place, we know of no internal heat of the earth to cauſe ſuch evaporation; or if that were allowed, yet it is quite incredible that there ſhould be any caverns ſo ſmooth and void of protuberances as to anſwer the ends of an alembic, in collecting and condenſing the vapours together in every place where fountains ariſe. There are others (as Varenius, &c.) who ſuppoſe that the water may riſe through the pores of the earth, as through capillary tubes by attraction. But hereby they ſhow, that they are quite unacquainted with what relates to the motion of a fluid through ſuch tubes: for when a capillary tube opens into a cavity at its upper end, or grows larger and larger, ſo as to ceaſe to be capillary at that end, the water will not aſcend through that tube into the cavity, or beyond where the tube is capillary; becauſe that part of the periphery of the cavity, which is partly above the ſurface of the water and partly below it, is not of the capillary kind. Nay, if the cavity is continually ſupplied with water, it will be attracted into the capillary tube, and run down it as through a funnel, if the lower end is immerged in the ſame fluid, as in this caſe it is ſuppoſed to be.

It has been a generally received opinion, and much eſpouſed by Mariotte (a diligent obſerver of nature), that the riſe of ſprings is owing to the rains and melted ſnow. According to him, the rain-water which falls upon the hills and mountains, penetrating the ſurface, meets with clay or rocks contiguous to each other; along which it runs, without being able to penetrate them, till, being got to the bottom of the mountain, or to a conſiderable diſtance from the top, it breaks out of the ground, and forms ſprings.

In order to examine this opinion, Mr Perrault, De la Hire, and D. Sideleau, endeavoured to make an eſtimate

Spring. eſtimate of the quantity of rain and ſnow that falls in the ſpace of a year, to ſee whether it would be ſufficient to afford a quantity of water equal to that which is annually diſcharged into the ſea by the rivers. The reſult of their inquiries was, that the quantity of rain and ſnow which fell in a year into a cylindrical veſſel would fill it (if ſecured from evaporating) to the height of about nineteen inches. Which quantity D. Sideleau ſhowed, was not ſufficient to ſupply the rivers; for that thoſe of England, Ireland, and Spain, diſcharge a greater quantity of water annually, than the rain, according to that experiment, is able to ſupply. Beſides which, another obſervation was made by them at the ſame time, viz. that the quantity of water raiſed in vapour, one year with another, amounted to about thirty-two inches, which is thirteen more than falls in rain: a plain indication that the water of fountains is not ſupplied by rain and melted ſnow.

Thus the true cauſe of the origin of fountains remained undiſcovered, till Dr Halley, in making his celeſtial obſervations upon the tops of the mountains at St Helena, about 800 yards above the level of the ſea, found, that the quantity of vapour which fell there (even when the ſky was clear) was ſo great, that it very much impeded his obſervations, by covering his glaſſes with water every half quarter of an hour; and upon that he attempted to determine by experiment the quantity of vapour exhaled from the ſurface of the ſea, as far as it riſes from heat, in order to try whether that might be a ſufficient ſupply for the water continually diſcharged by fountains. The proceſs of his experiment was as follows: He took a veſſel of water ſalted to the ſame degree with that of ſea water, in which he placed a thermometer; and by means of a pan of coals brought the water to the ſame degree of heat, which is obſerved to be that of the air in our hotteſt ſummer; this done, he fixed the veſſel of water with the thermometer in it to one end of a pair of ſcales, and exactly counterpoiſed it with weights on the other: then, at the end of two hours, he found, by the alteration made in the weight of the veſſel, that about a ſixtieth part of an inch of the depth of the water was gone off in vapour; and therefore, in twelve hours, one-tenth of an inch would have gone off. Now this accurate obſerver allows the Mediterranean Sea to be forty degrees long, and four broad, (the broader parts compenſating for the narrower, ſo that its whole ſurface is 160 ſquare degrees); which, according to the experiment, muſt yield at leaſt 5,280,000,000 tons of water: In which account no regard is had to the wind and the agitation of the ſurface of the ſea, both which undoubtedly promote the evaporation.

It remained now to compare this quantity of water with that which is daily conveyed into the ſame ſea by the rivers. The only way to do which was to compare them with ſome known river; and accordingly he takes his computation from the river Thames; and, to avoid all objections, makes allowances, probably greater than what were abſolutely neceſſary.

The Mediterranean receives the following conſiderable rivers, viz. the Iberus, the Rhone, the Tyber, the Po, the Danube, the Nieſter, the Boryſthenes, the Tanais, and the Nile. Each of theſe he ſuppoſes to bring down ten times as much water as the Thames, whereby he allows for ſmaller rivers which fall into the ſame ſea. The Thames, then, he finds by menſuration to diſcharge about 20,300,000 tons of water a-day. If therefore the above-laid nine rivers yield ten times as much water as the Thames doth, it will follow, that all of them together yield but 1827 millions of tons in a day, which is but little more than one-third of what is proved to be raiſed in vapour out of the Mediterranean in the ſame time. We have therefore from hence a ſource abundantly ſufficient for the ſupply of fountains. Spring.

Now having found that the vapour exhaled from the ſea is a ſufficient ſupply for the fountains, he proceeds in the next place to conſider the manner in which they are raiſed; and how they are condenſed into water again, and conveyed to the ſources of ſprings.

In order to this he conſiders, that if an atom of water was expanded into a ſhell or bubble, ſo as to be ten times as big in diameter as when it was water, that atom would become ſpecifically lighter than air; and therefore would riſe ſo long as the warmth which firſt ſeparated it from the ſurface of the water ſhould continue to diſtend it to the ſame degree; and conſequently, that vapours may be raiſed from the ſurface of the ſea in that manner, till they arrive at a certain height in the atmoſphere, at which they find air of equal ſpecific gravity with themſelves. Here they will float till, being condenſed by cold, they become ſpecifically heavier than the air, and fall down in dew; or being driven by the winds againſt the ſides of mountains (many of which far ſurpaſs the uſual height to which the vapours would of themſelves aſcend), are compelled by the ſtream of the air to mount up with it to the tops of them; where being condenſed into water, they preſently precipitate, and gleeting down by the crannies of the ſtones, part of them enters into the caverns of the hills; which being once filled, all the overplus of water that comes thither runs over by the loweſt place, and breaking out by the ſides of the hills forms ſingle ſprings. Many of theſe running down by the valleys between the ridges of the hills, and coming to unite, form little rivulets or brooks: many of theſe again meeting in one common valley, and gaining the plain ground, being grown leſs rapid, become a river; and many of theſe being united in one common channel, make ſuch ſtreams as the Rhine and the Danube; which latter, he obſerves, one would hardly think to be a collection of water condenſed out of vapour, unleſs we conſider how vaſt a tract of ground that river drains, and that it is the ſum of all thoſe ſprings which break out on the ſouth ſide of the Carpathian mountains, and on the north ſide of the immenſe ridge of the Alps, which is one continued chain of mountains from Switzerland to the Black Sea.

Thus one part of the vapours which are blown on the land is returned by the rivers into the ſea from whence it came. Another part falls into the ſea before it reaches the land; and this is the reaſon why the rivers do not return ſo much water into the Mediterranean as is raiſed in vapour. A third part falls on the low lands, where it affords nouriſhment to plants; yet it does not reſt there, but is again exhaled in vapour by the action of the ſun, and is either carried by the winds to the ſea to fall in rain or dew there, or elſe to the mountains to become the ſources of ſprings.

However, it is not to be ſuppoſed that all fountains are owing to one and the ſame cauſe; but that ſome proceed from rain and melted ſnow, which, ſubſiding through

Spring. through the surface of the earth, makes its way into certain cavities, and thence iſſues out in the form of ſprings; becauſe the waters of ſeveral are found to increaſe and diminiſh in proportion to the rain which falls: that others again, eſpecially ſuch as are ſalt, and ſpring near the ſea-ſhore, owe their origin to ſea-water percolated through the earth; and ſome to both theſe cauſes: though without doubt moſt of them, and eſpecially ſuch as ſpring near the tops of high mountains, receive their waters from vapours, as before explained.

This reaſoning of Dr Halley's is confirmed by more recent obſervations and diſcoveries. It is now found, that though water is a tolerable conductor of the electric fluid, dry earth is an electric *per ſe*, conſequently the dry land muſt always be in an electrified ſtate compared with the ocean, unleſs in ſuch particuler caſes as are mentioned under the article EARTHQUAKE, n° 82. It is alſo well known, that ſuch bodies as are in an electrified ſtate, whether *plus* or *minus*, will attract vapour, or other light ſubſtances that come near them. Hence the vapours that are raiſed from the ocean muſt neceſſarily have a tendency to approach the land in great quantity, even without the aſſiſtance of the wind, though this laſt muſt undoubtedly contribute greatly towards the ſame purpoſe, as Dr Halley juſtly obſerves. In like manner, the higher grounds are always in a more electrified ſtate than the lower ones: and hence the vapours having once left the ocean and approached the ſhore, are attracted by the high mountains, of which Mr Pennant gives an inſtance in Snowdon. Hence we may ſee the reaſon why ſprings are ſo common in the neighbourhood of mountains, they being ſo advantageouſly formed in every reſpect for collecting and condenſing the vapours into water.

The heat of ſprings is generally the ſame with the mean temperature of the atmoſphere. The mean temperature of the ſouth of England is 48°; in Scotland, near Edinburgh, it is 45°; in the north of Ireland it is 48°, and on the ſouth coaſt about 51°. At Upſal, in Sweden, it is 43°, and in Paris 53°. According to accurate experiments made by eminent philoſophers, the heat of the ſprings in theſe different countries correſponds with the medium temperature. We have not heard that ſimilar experiments have been made in other countries, or we ſhould have been careful to collect them. We do not, however, doubt but they have been made in moſt countries of Europe; yet we ſuſpect little attention has been paid to this ſubject within the tropical regions.

Though this coincidence of the heat of ſprings with the mean temperature of the climate where they flow, ſeems to be a general fact, yet it admits of many exceptions. In many parts of the world there are ſprings which not only exceed the mean temperature, but even the ſtrongeſt meridian heat ever known in the torrid regions. The following table will give a diſtinct notion of the degrees of heat which different ſprings have been found to poſſeſs, according to the experiments of philoſophers. It is neceſſary to remark, that experiments made upon the ſame ſprings, made by different perſons, vary a little from one another, which may be owing to many accidents eaſily accounted for. Where this is the caſe, we ſhall mention both the loweſt and higheſt degree of heat which has been aſcribed to the ſame ſpring, according to Fahrenheit's thermometer.

Places.	Springs.	Higheſt degree of heat.	Loweſt degree of heat.
Briſtol,	St Vincent's or the hot well,	84	76
Buxton,	Gentleman's bath,	82	
Matlock,		69	
Bath,	King's bath,	119	113
Aix-la-Chapelle,		146	136
Barege,		122	
Piſa,		104	
Caroline baths in Bohemia,	Prudel or furious,	165	
Iceland,	Geyzer,	212	

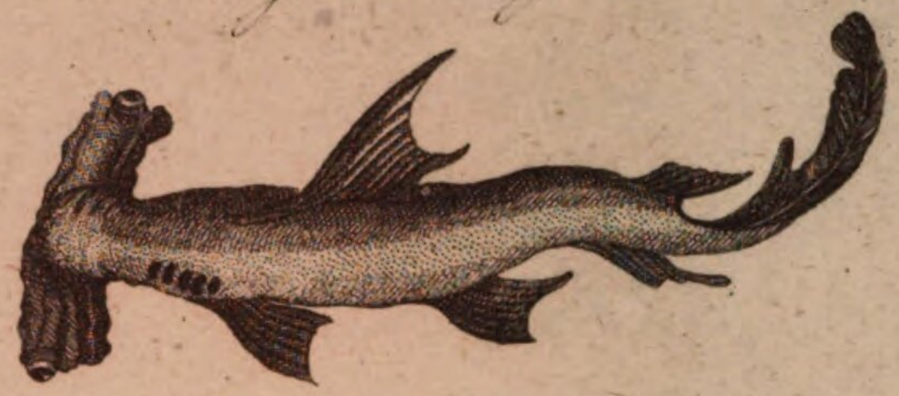
In cold countries, where congelation takes place, the heat of the earth is conſiderably above the freezing point, and continues ſo through the whole year. From experiments that have been made in mines and deep pits, it appears that this heat is uniform and ſtationary at a certain depth. But as the heat of theſe ſprings far exceeds the common heat of the internal parts of the earth, it muſt be occaſioned by cauſes peculiar to certain places; but what theſe cauſes are it is no eaſy matter to determine. We are certain, indeed, that hot ſprings receive their heat from ſome ſubterranean cauſe; but it is a matter of difficulty to inveſtigate how this heat is produced and preſerved. Theories, however, have been formed on this ſubject. The ſubterranean heat has been aſcribed to the electrical fluid, and to a great body of fire in the centre of the earth: But we ſuſpect that the nature of the electrical fluid and its effects are not ſufficiently underſtood. As to the ſuppoſition that the heat of ſprings is owing to a central fire, it is too hypothetical to require any refutation. From what then does this heat originate, and whence is the fuel which has produced it for ſo many ages? To enable us to anſwer theſe queſtions with preciſion, more information is neceſſary than we have hitherto obtained reſpecting the ſtructure of the internal parts of the earth. It is peculiarly requiſite that we ſhould be made acquainted with the foſſils which are moſt common in thoſe places where hot ſprings abound. We ſhould then perhaps diſcover that hot ſprings always paſs thro' bodies of a combuſtible nature. It is well known to chemiſts, that when water is mixed with the vitriolic acid, a degree of heat is produced ſuperior to that of boiling water. It is alſo an eſtabliſhed fact, that when water meets with pyrites, that is, a mixture of ſulphur and iron, a violent inflammation takes place. If, therefore, we could prove that theſe materials exiſt in the ſtrata from which hot ſprings are derived, we ſhould be enabled to give a ſatisfactory account of this curious phenomenon. As ſome apology for this ſuppoſition, we may add, that moſt of the hot ſprings mentioned above have been found by analyſis to be impregnated with ſulphur, and ſome of them with iron. It muſt, however, be acknowledged, that the hot ſprings of Iceland, which are 112°, the heat of boiling water, according to an accurate analyſis of their contents by the ingenious Dr Black, were neither found to contain iron nor ſulphur. It will therefore, perhaps, be neceſſary that we ſhould wait with patience, and continue to collect facts, till the ſciences of chemiſtry and mineralogy ſhall be ſo far advanced as to enable us to form a permanent theory on this ſubject. *Gray's Letters from Germany and Switzerland.*

Springs are of different kinds. Some are perennial,

SQUALI *SHARKS.*

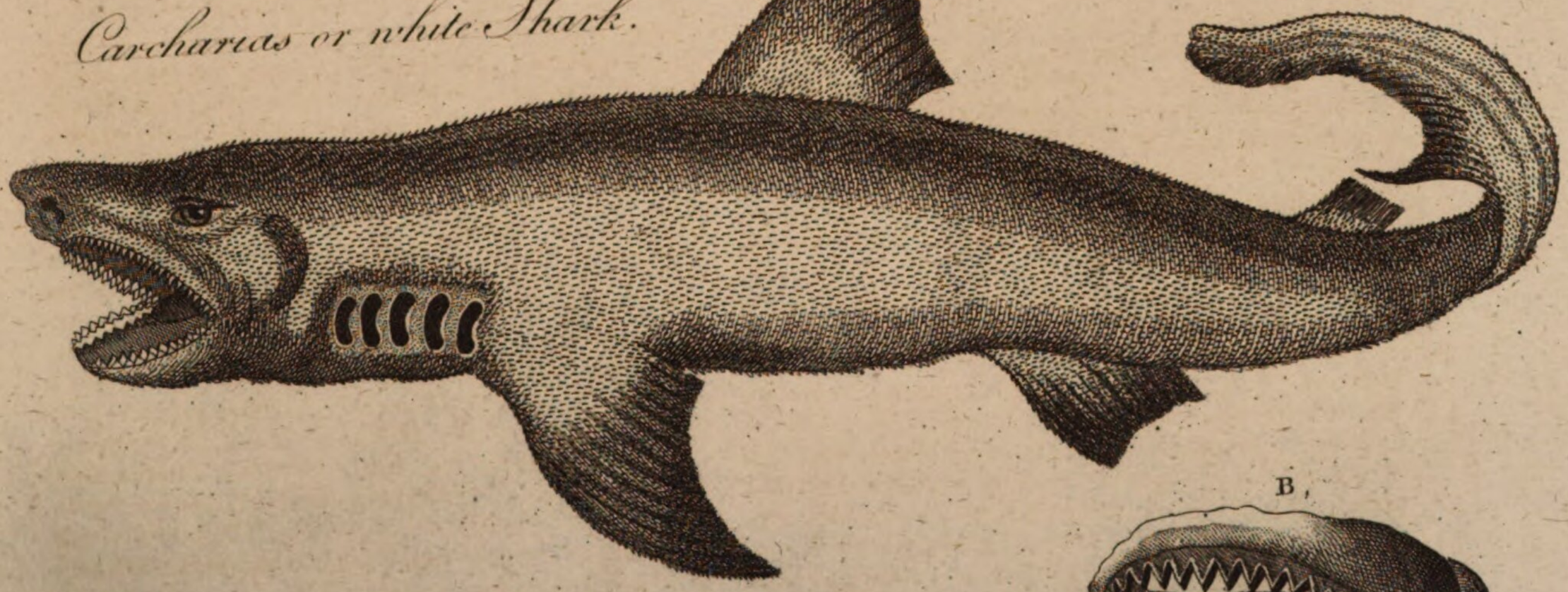
Zygæna or Balana Fish.

Tigrinus or Tigre.



Maximus or Basking Shark.

Carcharias or white Shark.



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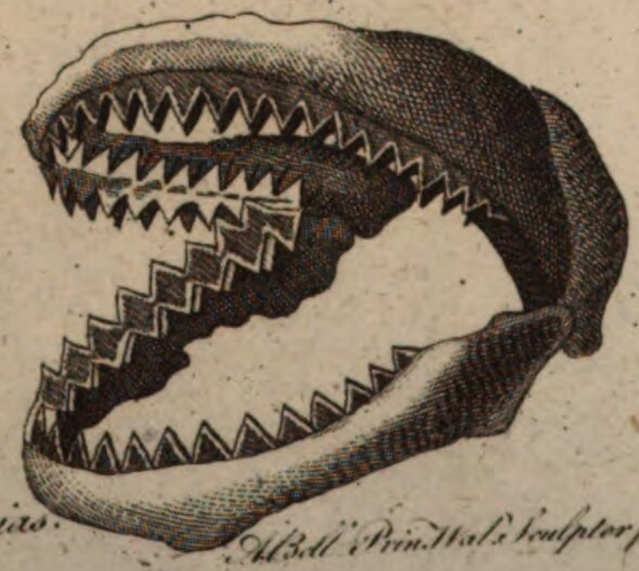

B.

A. *A front view of the Tigre's head.*

B. *The jaws and head of the Carcharias.*

W.Bell Prin. Wal.s Sculptor fec!

Spring || Spun.

or continue to flow during the whole year; others flow only during the rainy ſeaſon; ſome ebb and flow. At Torbay there is one of this kind, which ebbs and flows five or ſix inches every hour. There is another near Coriſo in Italy, which ebbed and flowed three times a-day in the time of Pliny, and continues to do ſtill. A ſpring near Henly ſometimes flows for two years together, and then dries up for an equal period. The cauſe of this is explained under the article HYDROSTATICS, n° 26. For the ingredients found in ſprings, ſee *MINERAL Waters, and* WATER.

SPRING, in mechanics, denotes a thin piece of tempered ſteel, or other elaſtic ſubſtance, which being wound up ſerves to put machines in motion by its elaſticity, or endeavours to unbend itſelf; ſuch is the ſpring of a watch, clock, or the like.

SPRING, *Ver*, in coſmography, denotes one of the ſeaſons of the year; commencing, in the northern parts of the world, on the day the ſun enters the firſt degree of Aries, which is about the 10th day of March, and ending when the ſun leaves Gemini; or, more ſtrictly and generally, the ſpring begins on the day when the diſtance of the ſun's meridian altitude from the zenith, being on the increaſe, is at a medium between the greateſt and leaſt. The end of the ſpring coincides with the beginning of ſummer. See SUMMER.

SPRING-Tide. See ASTRONOMY-*Index*, and TIDE.

Burning SPRINGS. See *BURNING-Springs*.

SPRINGER, or *SPRING-Bok*, in zoology. See CAPRA.

SPRIT, a ſmall boom or pole which croſſes the ſail of a boat diagonally, from the maſt to the upper hindmoſt corner of the ſail, which it is uſed to extend and elevate; the lower end of the ſprit reſts in a ſort of wreath or collar called the *ſmotter*, which encircles the maſt in that place.

SPRITSAIL. See SAIL and SHIP.

SPRITSAIL-Topſail. See SAIL and SHIP.

SPRUCE-TREE. See PINUS.

SPRUCE-Beer, a cheap and wholeſome liquor, which is thus made: Take of water 16 gallons, and boil the half of it. Put the water thus boiled, while in full heat, to the reſerved cold part, which ſhould be previouſly put into a barrel or other veſſel; then add 16 pounds of treacle or molaſſes, with a few table ſpoonfuls of the eſſence of ſpruce, ſtirring the whole well together; add half a pint of yeaſt, and keep it in a temperate ſituation, with the bung hole open, for two days, till the fermentation be abated. Then cloſe it up or bottle it off, and it will be fit for being drunk in a few days afterwards. In North America, and perhaps in other countries, where the black and white ſpruce-firs abound, inſtead of adding the *eſſence* of the ſpruce at the ſame time with the molaſſes, they make a decoction of the leaves and ſmall branches of theſe trees, and find the liquor equally good. It is a powerful anti-ſcorbutic, and may prove very uſeful in long ſea voyages.

SPUNGE, or SPONGE. See SPONGIA.

SPUNGING, in gunnery, the cleaning of the inſide of a gun with a ſpunge, in order to prevent any ſparks of fire from remaining in it, which would endanger the life of him that ſhould load it again.

SPUN-YARN, among ſailors, is a kind of line made from rope yarn, and uſed for ſeizing or faſtening things together.

SPUNK, in botany. See BOLETUS.

Spunk || Squalus.

SPUR, a piece of metal conſiſting of two branches encompaſſing a horſeman's heel, and a rowel in form of a ſtar, advancing out behind to prick the horſe.

SPUR-Winged Water Hen. See PARRA.

SPURGE, in botany. See EUPHORBIA.

SPURGE-Laurel. See DAPHNE.

SPURREY, in botany. See SPERGULA.

SPY, a perſon hired to watch the actions, motions, &c. of another; particularly what paſſes in a camp. When a ſpy is diſcovered, he is hanged immediately.

SQUADRON, in military affairs, denotes a body of horſe whoſe number of men is not fixed; but is uſually from 100 to 200.

SQUADRON of Ships, either implies a detachment of ſhips employed on any particular expedition, or the third part of a naval armament.

SQUADS, in a military ſenſe, are certain diviſions of a company into ſo many ſquads, generally into three or four. The uſe of forming companies into as many ſquads of inſpection as it has ſerjeants and corporals, is proved by thoſe regiments who have practiſed that method; as by it the irregularity of the ſoldiers is conſiderably reſtrained, their dreſs improved, and the diſcipline of the regiment in general moſt remarkably forwarded. Every officer ſhould have a roll of his company by ſquads.

SQUALL, a ſudden and violent blaſt of wind, uſually occaſioned by the interruption and reverberation of the wind from high mountains. Theſe are very frequent in the Mediterranean, particularly that part of it which is known by the name of the *Levant*, as produced by the repulſion and new direction which the wind meets with in its paſſage between the various iſlands of the Archipelago.

SQUALUS, SHARK, in ichthyology; a genus arranged by Linnæus under the claſs of *amphibia*, and the order of *nantes*, but by Gmelin referred to the claſs of *piſces*, and order of *chondropterygii*. The head is obtuſe; on the ſides of the neck there are from 4 to 7 ſemilunar ſpiracles. The eyes are oblong, vertical, half covered, and before the *foramen temporale*. The mouth is ſituated in the anterior and lower part of the head, and is armed with ſeveral rows of teeth, which are ſerrated, acute, partly moveable and partly fixed, and unequal in form. The body is oblong, tapering and rough, with very tender prickles. The ventral fins are much leſs than the pectoral, and are ſituated round the anus and genitals. There are 32 ſpecies; the iſabella canicula or greater dog fiſh; catulus or ſmaller dog-fiſh; ſtellaris; galeus or tope; muſtelus or ſmooth hound; cirratus; barbatus or barbu; tigrinus or tigre; Africanus or galonné; ocellatus or oeillé; zygæna or balance-fiſh; tiburo or pantouflier of Brouſſonet; griſeus or griſet; vulpes or ſea-fox; longicaudus; glaucus or blue ſhark; cornubius, porbeagle, or beaumaris-ſhark; cinereus or perlon; maximus; carcharias or white ſhark; priſtis or ſcie; ſpinoſus or bouclé; acanthias or picked dog fiſh; fernandinus; ſpinax or ſagre; ſquamoſus or ecailleux; centrina or humantin; indicus; Americanus or liche; ſquatina or angel fiſh; maſſaſa; and kunal. The following are the moſt remarkable:

1. The *iſabella* has a wrinkly ſpotted ſkin, and the anterior dorſal fin is perpendicular to the abdominal fins. The body is ſomewhat flat; the head ſhort, large, and obtuſe.

Squalus.

obtuſe. The teeth are diſpoſed in ſix rows, compreſſed, ſhort, and triangular, having a notch on each ſide of their baſes. The eyes are ſunk; the iris is of a copper colour, and the pupil is black and oblong. The fins of the back are almoſt ſquare; the caudal fin is divided into two lobes, and the lateral line is parallel to the back. The upper part of the body is of a reddiſh aſh-colour, with blackiſh ſpots diſpoſed irregularly. The under part is of a dirty white hue. This ſpecies is found near New Zealand, and is about 2½ feet long.

2. *Canicula*, greater dog-fiſh, or ſpotted ſhark, is diſtinguiſhed by large noſtrils, which are covered by a lobe and worm-ſhaped flap, or by the poſition of the anal fin, which is at an equal diſtance from the anus and tail. The body is ſpotted; the head is ſmall, with a ſhort ſnout; the eyes are oblong; the iris whitiſh; the mouth is large and oblong, armed with three rows of teeth; the tongue is cartilaginous; the anus is before the middle of the body; the firſt dorſal fin is behind the ventral fins; the other, which is leſs, is almoſt oppoſite the anal fin; the caudal fin is narrow and marginated. This ſpecies is found in almoſt every ſea, is about four feet long, extremely voracious, generally feeding on fiſhes, and is long lived. The ſkin, which is ſpotted like a leopard's, is uſed when dried for various purpoſes.

3. *Catulus*, ſmaller dog fiſh, has a large head; the pupil of the eyes is black; the iris white; the ſnout is of a bright hue; the mouth, which is large, is ſituated between the noſtrils, and is armed with four rows of teeth, ſerrated with three points bent inwards; thoſe in the middle between the two mandibles are longer than the reſt. The tongue is broad and ſmooth; the ſpiracles are five; the back is tapering and yellowiſh; the ſides are ſomewhat compreſſed; the tail longer than the body, and the caudal fin is narrow and marginated; the anterior anal and dorſal fins are behind the ventral; the poſterior dorſal fin is oppoſite to the anal. It inhabits the Mediterranean, Northern, and Indian Ocean, and is two or three feet long.

4. *Stellaris*, or greater cat fiſh. The head is marked with points; the abdominal fins are united and ſharp at the apex; the dorſal fins extend almoſt to the tail; the ſkin is reddiſh, marked with black ſpots of different ſizes, and is of a dirty aſh colour below. It is from two to ſix feet long; reſembles the canicula, but diſtinguiſhed by larger and fewer ſpots, by a ſnout ſomewhat longer, a tail ſomewhat ſhorter, and noſtrils almoſt ſhut. It brings forth 19 or 20 young at a time. It inhabits the European ſeas, living chiefly on ſhell fiſh, molluſcæ, and other ſmall fiſhes. The dorſal fins are equal; the anterior one being behind the middle of the body, and the poſterior one being a little behind the anal.

5. *Tigrinus*, or tigre, is about 15 feet long; the body is long, of unequal thickneſs, black, interſperſed with white ſtripes and ſpots, irregularly and tranſverſely.—The head is large; the mouth low and tranſverſe, the upper jaw having two curls; the upper lip is thick and prominent; there are five ſpiracles on each ſide, the two laſt being united ſo as to give the appearance only of four; the mandibles are armed with very ſmall pointed teeth; the tongue is ſhort and thick; the eyes ſmall and oblong; the pupil azure coloured; the iris black. The abdomen is broad; the pectoral fins are broad, and rounded at the extremity. The anterior dorſal is oppoſite to the ventral fins, and the poſterior dorſal fin to the anal. The tail is compreſſed on both ſides, and the fin which terminates it is hollow. The tigrinus is found in the Indian Ocean, and lives chiefly on ſhell fiſh. See Plate CCCCLXXVI. fig. 1.

Squalus.

7. *Zygæna*, *marteau*, or balance-fiſh, is frequently ſix feet long, and weighs 500 lbs. The head is elongated on each ſide; the fore part is bent back, and convex both above and below. At the extremities of the elongated part are the eyes, which are large, prominent, and directed downwards; the iris is of a golden colour; the mouth is arched, and near the beginning of the trunk. It has a horrible appearance from the teeth, which are arranged in three or four rows, and are broad, pointed, and ſerrated on both ſides. The tongue is thick, broad, and like a man's. The trunk is long and tapering: the fins are ſemicircular on the margin, and black at the baſis; the ventral fins are ſeparate; the anal and poſterior dorſal fins are ſmall; the anterior dorſal fin is large, and near the head; the caudal is long.—This ſpecies inhabits the Mediterranean Sea and the Indian Ocean. It is one of the moſt voracious of the whole tribe. See fig. 2.

8. *Vulpes*, or ſea-fox, is moſt remarkable for the great length of its tail, the body being about ſeven feet and the tail ſix feet long. The head is ſhort and conical; the eyes are large; the jaws are armed in a dreadful manner with three rows of triangular, compreſſed, and pointed teeth; the tongue is blunt; the lateral line is ſtraight. The anterior dorſal fin is placed about the middle of the back; the poſterior, which conſiſts of two pointed lobes, is oppoſite to the anal fin; the ventral fins are very near one another; the anal is acuminated; the inferior lobe of the tail is about a foot long; the upper, which is ſhaped like a ſcythe, is five times longer. This ſpecies inhabits the Mediterranean, the coaſt of Scotland and England. It is covered with ſmall ſcales; its back is aſh-coloured, belly whitiſh. It is extremely voracious. The ancients ſtyled this fiſh αλωπηξ, and *vulpes*, from its ſuppoſed cunning. They believed, that when it had the misfortune to have taken a bait, it ſwallowed the hook till it got at the cord, which it bit off, and ſo eſcaped.

9. *Glaucus*, or blue ſhark, is about ſeven feet long. The colour of the back is a fine blue; the belly a ſilvery white; the head is flat; the eyes ſmall and roundiſh; the teeth are almoſt triangular, elongated, and pointed, but not ſerrated. The anus is very near the tail; the anterior dorſal fin is ſituated before the ventral fins, about the middle of the body, and is almoſt triangular; the poſterior dorſal fin is equal to the anal fin, and is placed nearer the tail; the pectoral fins are large, long, and marginated; and the ventral are blue above and white below; the caudal is blue, divided into two lobes, of which the ſuperior is much longer than the inferior lobe. This ſpecies is frequent in every ſea, and is fierce, but not very deſtructive in our ſeas.

10. The *maximus*, baſking ſhark, or the ſun-fiſh of the Iriſh. This ſpecies has been long known to the inhabitants of the ſouth and weſt of Ireland and Scotland, and thoſe of Caernarvonſhire and Angleſea; but having never been conſidered in any other than a commercial view, is deſcribed by no Engliſh writer except Mr Pennant; and, what is worſe, miſtaken for and confounded with the luna of Rondeletius, the ſame

that

Squalus. that our Engliſh writers call the ſun-fiſh. The Iriſh and Welſh give it the ſame name, from its lying as if to ſun itſelf on the ſurface of the water; and for the ſame Fig. 3. reaſon Mr Pennant calls it the baſking ſhark. It was long taken for a ſpecies of whale, till Mr Pennant pointed out the bronchial orifices on the ſides, and the perpendicular ſite of the tail. Theſe are migratory fiſh, or at leaſt it is but in a certain number of years that they are ſeen in multitudes on the Welſh ſeas, though in moſt ſummers a ſingle, and perhaps a ſtrayed fiſh appears. They inhabit the northern ſeas, even as high as the arctic circle. They viſited the bays of Caernarvonſhire and Angleſea in vaſt ſhoals in the ſummers of 1756 and a few ſucceeding years, continuing there only the hot months; for they quitted the coaſt about Michaelmas, as if cold weather was diſagreeable to them. Some old people ſay they recollect the ſame ſort of fiſh viſiting theſe ſeas in vaſt numbers about 40 years ago. They appear in the Frith of Clyde, and among the Hebrides, in the month of June, in ſmall droves of ſeven or eight, but oftener in pairs. They continue in thoſe ſeas till the latter end of July, when they diſappear.

They have nothing of the fierce and voracious nature of the ſhark kind, and are ſo tame as to ſuffer themſelves to be ſtroked; they generally lie motionleſs on the ſurface, commonly on their bellies, but ſometimes, like tired ſwimmers, on their backs. Their food ſeems to conſiſt entirely of ſea plants, no remains of fiſh being ever diſcovered in the ſtomachs of numbers that were cut up, except ſome green ſtuff, the half-digeſted parts of algæ, and the like. Linnæus ſays it feeds on meduſæ.

At certain times, they are ſeen ſporting on the waves, and leaping with vaſt agility ſeveral feet out of the water. They ſwim very deliberately, with the dorſal fins above water. Their length is from three to twelve yards, and ſometimes even longer. Their form is rather ſlender, like others of the ſhark kind. The upper jaw is much longer than the lower, and blunt at the end. The tail is very large, and the upper part remarkably longer than the lower. The colour of the upper part of the body is a deep leaden; the belly white. The ſkin is rough like ſhagreen, but leſs ſo on the belly than the back. In the mouth, towards the throat, is a very ſhort ſort of whale-bone. The liver is of a great ſize, but that of the female is the largeſt; ſome weigh above 1000 pounds, and yield a great quantity of pure and ſweet oil, fit for lamps, and alſo much uſed to cure bruiſes, burns, and rheumatic complaints. A large fiſh has afforded to the captors a profit of 20 l. They are viviparous; a young one about a foot in length being found in the belly of a fiſh of this kind. The meaſurements of one found dead on the ſhore of Loch Ranza in the iſle of Arran were as follow: The whole length, 27 feet 4 inches; firſt dorſal fin, 3 feet; ſecond, 1 foot; pectoral fin, 4 feet; ventral, 2 feet; the upper lobe of the tail, 5 feet; the lower, 3.

They will permit a boat to follow them, without accelerating their motion till it comes almoſt within contact when a harponeer ſtrikes his weapon into them, as near to the gills as poſſible. But they are often ſo inſenſible as not to move till the united ſtrength of two men have forced in the harpoon deeper. As ſoon as they perceive themſelves wounded, they fling up their tail and plunge headlong to the bottom; and frequently coil the rope round them in their agonies, attempting to diſengage the harpoon by rolling on the ground, for it is often found greatly bent. As ſoon as they diſcover that their efforts are in vain, they ſwim away with amazing rapidity, and with ſuch violence, that there has been an inſtance of a veſſel of 70 tons having been towed away againſt a freſh gale. They ſometimes run off with 200 fathoms of line, and with two harpoons in them; and will employ the fiſhers for 12, and ſometimes for 24 hours, before they are ſubdued. When killed, they are either hauled on ſhore, or, if at a diſtance from land, to the veſſel's ſide. The liver (the only uſeful part), is taken out, and melted into oil in kettles provided for that purpoſe. A large fiſh will yield eight barrels of oil, and two of worthleſs ſediment. Squalus.

11. *Carcharias*, *requin*, or white ſhark, is often 30 feet long, and according to Gillius weighs 4000 pounds. The mouth of this fiſh is ſometimes furniſhed with a ſix-fold row of teeth, flat, triangular, and exceedingly ſharp at their edges, and finely ſerrated. Mr Pennant had one rather more than an inch and a half long. Grew ſays, that thoſe in the jaws of a ſhark two yards in length are not half an inch; ſo that the fiſh to which this tooth belonged muſt have been ſix yards long, provided the teeth and body keep pace in their growth.

This dreadful apparatus, when the fiſh is in a ſtate Fig. 4. of repoſe, lies quite flat in the mouth; but when he ſeizes his prey, he has power of erecting them by the help of a ſet of muſcles that join them to the jaw. The mouth is placed far beneath; for which reaſon theſe, as well as the reſt of the kind, are ſaid to be obliged to turn on their backs to ſeize their prey; which is an obſervation as ancient as the days of Pliny. The eyes are large; the back broad, flat, and ſhorter than that of other ſharks. The tail is of a ſemilunar form, but the upper part is longer than the lower. It has vaſt ſtrength in the tail, and can ſtrike with great force; ſo that the ſailors inſtantly cut it off with an axe as ſoon as they draw one on board. The pectoral fins are very large; which enables it to ſwim with great ſwiftneſs. The colour of the whole body and fins is a light aſh. The ancients were acquainted with this fiſh; and Oppian gives a long and entertaining account of its capture. Their fleſh is ſometimes eaten, but is eſteemed coarſe and rank.—They are the dread of the ſailors in all hot climates, where they conſtantly attend the ſhips in expectation of what may drop over-board: a man that has that misfortune periſhes without redemption; they have been ſeen to dart at him like gudgeons at a worm. A maſter of a Guinea ſhip informed Mr Pennant, that a rage of ſuicide prevailed among his new-bought ſlaves, from a notion the unhappy creatures had, that after death they ſhould be reſtored again to their families, friends, and country. To convince them at leaſt that they ſhould not reanimate their bodies, he orderd one of their corpſes to be tied by the heels to a rope and lowered into the ſea; and though it was drawn up again as faſt as the united force of the crew could be exerted, yet in that ſhort ſpace the ſharks had devoured every part but the feet, which were ſecured at the end of the cord.

Swimmers very often periſh by them; ſometimes they

Squalus. they loſe an arm or leg, and ſometimes are bit quite aſunder, ſerving but for two morſels for this ravenous animal: a melancholy tale of this kind is related in a Weſt India ballad, preſerved in Dr Percy's Relics of ancient Engliſh Poetry.

This ſpecies inhabits the abyſs of the ocean, and only appears on the ſurface when allured by its prey. It is the moſt voracious of all animals, not even it is ſaid ſparing its own offspring, and often ſwallowing its prey entire. At the famous naval battle of the 12th of April 1782, when the Cæſar, one of the French ſhips of the line, was ſet on fire, the ſailors threw themſelves into the ſea, Sir Charles Douglas obſerved great numbers of theſe ſharks, which lay between the French and Britiſh fleets, inſtantly ſeize on the unhappy victims. He ſeveral times ſaw two of them diſputing about their prey, each ſeizing a leg, and at length diſappearing, dragging the body along with them. Notwithſtanding the continued roar of artillery, he heard diſtinctly the cries of thoſe unhappy men.

12. *Priſtis, ſcie*, or ſaw-fiſh, is ſometimes 15 feet long, ſmooth, black on the upper parts, aſh-coloured on the ſides, and white underneath. The head is flat and conical; the beak or ſnout projecting from the noſe is about five feet long, covered with a coriaceous ſkin, and armed on each ſide, generally with 24 long, ſtrong, and ſharp-pointed teeth; but the number varies with age. The teeth are granulated; the eyes large, the iris of a golden colour, and the ſpiracles five. The anterior dorſal fin correſponds to thoſe of the belly; the poſterior is ſituated in the middle, between the former and apex of the tail; the pectoral fins are broad and long; the caudal is ſhorter than in the other ſpecies. It inhabits all the ſeas from Greenland to Brazil: and is found alſo in the Indian Ocean. It is harmleſs.

13. *Spinax, ſagre*, or picked dog-fiſh, takes its name from a ſtrong and ſharp ſpine placed juſt before each of the back-fins, diſtinguiſhing it at once from the reſt of the Britiſh ſharks. The noſe is long, and extends greatly beyond the mouth, but is blunt at the end. The teeth are diſpoſed in two rows, are ſmall and ſharp, and bend from the middle of each jaw towards the corners of the mouth. The back is of a browniſh aſh-colour; the belly white.—It grows to the weight of about 20 pounds. This ſpecies ſwarms on the coaſts of Scotland, where it is taken, ſplit, and dried; and is a food among the common people. It forms a ſort of inland commerce, being carried on womens backs 14 or 16 miles up the country, and ſold or exchanged for neceſſaries.

14. *Squatina*, angel-fiſh, is from ſix to eight feet long, has a large head; teeth broad at their baſe, but ſlender and very ſharp above, and diſpoſed in five rows all round the jaws. Like thoſe of all ſharks, they are capable of being raiſed or depreſſed by means of muſcles uniting them to the jaws, not being lodged in ſockets as the teeth of cetaceous fiſh are. The back is of a pale aſh-colour, and very rough; along the middle is a prickly tuberculated line: the belly is white and ſmooth. The pectoral fins are very large, and extend horizontally from the body to a great diſtance; they have ſome reſemblance to wings, whence its name. The ventral fins are placed in the ſame manner, and the double penis is placed in them; which forms another character of the males in this genus.

This is the fiſh which connects the genus of rays and ſharks, partaking ſomething of the character of both; yet is an exception to each in the ſituation of the mouth, which is placed at the extremity of the head. It is a fiſh not unfrequent on moſt of our coaſts, where it prowls about for prey like others of the kind. It is extremely voracious; and, like the ray, feeds on flounders and flat fiſh, which keep at the bottom of the water. It is extremely fierce, and dangerous to be approached. Mr Pennant mentions a fiſherman whoſe leg was terribly torn by a large one of this ſpecies, which lay within his nets in ſhallow water, and which he went to lay hold of incautiouſly. The aſpect of theſe, as well as the reſt of the genus, have much malignity in them: their eyes are oblong, and placed lengthwiſe in their head, ſunk in it, and overhung by the ſkin, and ſeem fuller of malevolence than fire. Their ſkin is very rough; the ancients made uſe of it to poliſh wood and ivory, as we do at preſent that of the greater dog-fiſh. The fleſh is now but little eſteemed on account of its coarſeneſs and rankneſs; yet Archeſtratus (as quoted by Athenæus, p. 319.), ſpeaking of the fiſh of Miletus, gives this the firſt place, in reſpect to delicacy, of the whole cartilaginous tribe. They grow to a great ſize; being ſometimes near an hundred weight.

Sharks are ſeldom deſtructive in the temperate regions; it is in the torrid zone that their ravages are moſt frequent. In the Weſt Indies accidents happen from them almoſt every day.

"During the American war in 1780, while the Pallas frigate was lying in Kingſton harbour, a young North American jumped overboard one evening to make his eſcape, and periſhed by a ſhark in a ſhocking manner. *Moſeley on Tropical Diſeaſes.*

"He had been captured in a ſmall veſſel, loſt all his property, and was detained by compulſion in the Engliſh navy, to ſerve in a depredatory war againſt his country. But he, animated with that ſpirit which pervaded every boſom in America, reſolved, as ſoon as he arrived at ſome port, to releaſe himſelf from the mortifying ſtate of employing his life againſt his country, which, as he ſaid when dying, he was happy to lay down, as he could not employ it againſt her enemies.

"He plunged into the water; the Pallas was a quarter of a mile from the ſhore. A ſhark perceived him, and followed him, very quietly, till he came to a ſtate of reſt, near the ſhore: where, as he was hanging by a rope, that moored a veſſel to a wharf, ſcarcely out of his depth, the ſhark ſeized his right leg, and ſtripped the fleſh entirely away from the bones, and took the foot off at the ancle. He ſtill kept his hold, and called to the people in the veſſel near him, who were ſtanding on the deck and ſaw the affair. The ſhark then ſeized his other leg, which the man by his ſtruggling diſengaged from his teeth, but with the fleſh cut through down to the bone, into a multitude of narrow ſlips. The people in the veſſel threw billets of wood into the water, and frightened the ſhark away. The young man was brought on ſhore. Dr Moſeley was called to him; but he had loſt ſo much blood before any aſſiſtance could be given him, that he expired before the mangled limbs could be taken off.

"A few weeks before this accident happened, a ſhark, of 12 feet in length, was caught in the harbour; and

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Squalus. on being opened, the entire head of a man was found in his ſtomach. The ſcalp, and fleſh of the face, were macerated to a ſoft pulpy ſubſtance; which, on being touched, ſeparated entirely from the bones. The bones were ſomewhat ſoftened, and the ſutures looſened."

The following extraordinary inſtance of intrepidity and friendſhip is well worth recording. It is given on the authority of Mr Hughes, who publiſhed a natural hiſtory of Barbadoes. About the latter end of Queen Anne's wars, captain John Beanis, commander of the York Merchant, arrived at Barbadoes from England. Having diſembarked the laſt part of his lading, which was coals, the ſailors, who had been employed in that dirty work, ventured into the ſea to waſh themſelves; there they had not been long before one on board eſpied a large ſhark making toward them, and gave them notice of their danger; upon which they ſwam back, and all reached the boat except one: him the monſter overtook almoſt within reach of the oars, and griping him by the ſmall of his back, ſoon cut him aſunder, and as ſoon ſwallowed the lower part of his body; the remaining part was taken up and carried on board, where a comrade of his was, whoſe friendſhip with the deceaſed had been long diſtinguiſhed by a reciprocal diſcharge of all ſuch endearing offices as implied an union and ſympathy of ſouls. When he ſaw the ſevered trunk of his friend, it was with an horror and emotion too great for words to paint. During this affecting ſcene, the inſatiate ſhark was ſeen traverſing the bloody ſurface in ſearch of the remainder of his prey; the reſt of the crew thought themſelves happy in being on board, he alone unhappy, that he was not within reach of the deſtroyer. Fired at the ſight, and vowing that he would make the devourer diſgorge, or be ſwallowed himſelf in the ſame grave, he plunges into the deep, armed with a ſharp-pointed knife. The ſhark no ſooner ſaw him, but he made furiouſly toward him; both equally eager, the one of his prey, the other of revenge. The moment the ſhark opened his rapacious jaws, his adverſary dexterouſly diving, and graſping him with his left hand ſomewhat below the upper fins, ſucceſsfully employed his knife in his right hand, giving him repeated ſtabs in the belly; the enraged ſhark, after many unavailing efforts, finding himſelf overmatched in his own element, endeavoured to diſengage himſelf, ſometimes plunging to the bottom, then mad with pain, rearing his uncouth form, now ſtained with his own ſtreaming blood, above the foaming waves. The crews of the ſurrounding veſſels ſaw the unequal combat, uncertain from which of the combatants the ſtreams of blood iſſued; till at length the ſhark, much weakened by the loſs of blood, made toward the ſhore, and with him his conqueror; who, fluſhed with an aſſurance of victory, puſhed his foe with redoubled ardour, and, by the help of an ebbing tide, dragged him on ſhore, ripped up his bowels, and united and buried the ſevered carcaſe of his friend."

"It is evident (ſays Dr Moſeley, to whoſe valuable work we are indebted for the ſtory of the American related above), that digeſtion in theſe animals is not performed by trituration, nor by the muſcular action of the ſtomach; though nature has furniſhed them with a ſtomach of wonderful force and thickneſs, and far exceeding that of any other creature. Whatever their force of digeſtion is, it has no effect upon their young ones, which always retreat into their ſtomachs in time of danger. Squamaria Stabbing.

"That digeſtion is not performed by heat in fiſh, is equally evident. Being on the Banks of Newfoundland in Auguſt 1782, I opened many cod-fiſh, and ripped up their ſtomachs juſt as they came alive out of the water; in which were generally found ſmall oyſters, muſcles, cockles, and crabs, as well as ſmall fiſhes of their own and other ſpecies. The coldneſs of the ſtomach of theſe fiſhes is far greater than the temperature of the water out of which they are taken; or of any other part of the fiſh, or of any other ſubſtance of animated nature I ever felt. On wrapping one of them round my hand, immediately on being taken out of the fiſh, it cauſed ſo much aching and numbneſs that I could not endure it long."

SQUAMARIA, in botany. See LATHRÆA.

SQUAMOUS, in anatomy, a name given to the ſpurious or falſe ſutures of the ſkull, becauſe compoſed of ſquamæ, or ſcales like thoſe of fiſhes.

SQUARE, in geometry, a quadrilateral figure both equilateral and equiangular. See GEOMETRY.

SQUARE-Root. See ALGEBRA, Part I. Chap. iv. and ARITHMETIC, n° 33. and 34.

Hollow SQUARE, in the military art, a body of foot drawn up with an empty ſpace in the middle, for the colours, drums, and baggage, faced and covered by the pikes every way, to keep off the horſe.

SQUARE, among mechanics, an inſtrument conſiſting of two rules or branches, faſtened perpendicularly at one end of their extremities, ſo as to form a right angle. It is of great uſe in the deſcription and menſuration of right angles, and laying down perpendiculars.

SQUARE-Rigged, an epithet applied to a ſhip whoſe yards are very long. It is alſo uſed in contradiſtinction to all veſſels whoſe ſails are extended by ſtays or lateen-yards, or by booms and gaffs; the uſual ſituation of which is nearly in the plane of the keel; and hence,

SQUARE-Sail, is a ſail extended to a yard which hangs parallel to the horizon, as diſtinguiſhed from the other ſails which are extended by booms and ſtays placed obliquely. This ſail is only uſed in fair winds, or to ſcud under in a tempeſt. In the former caſe, it is furniſhed with a large additional part called the *bonnet*, which is then attached to its bottom, and removed when it is neceſſary to SCUD. See SCUDDING.

SQUATINA. See SQUALUS.

SQUILL, in botany. See SCILLA.

SQUILLA, the name of a ſpecies of cancer. See CANCER.

SQUINTING. See MEDICINE, n° 383.

SQUIRREL, in zoology. See SCIURUS.

STABBING, in law. The offence of mortally ſtabbing another, though done upon ſudden provocation, is puniſhed as murder; the benefit of clergy being taken away from it by ſtatute. (See MURDER). For by Ja. I. c. 8. when one thruſts or ſtabs another, not then having a weapon drawn, or who hath not then firſt ſtricken the party ſtabbing, ſo that he dies thereof within ſix months after, the offender ſhall not have the benefit of clergy, though he did it not of malice aforethought. This ſtatute was made on account of the frequent quarrels and ſtabbings with ſhort daggers between the Scotch and the Engliſh, at the acceſſion

Stachys. ceſſion of James I.; and being therefore of a temporary nature, ought to have expired with the miſchief which it meant to remedy. For, in point of ſolid and ſubſtantial juſtice, it cannot be ſaid that the mode of killing, whether by ſtabbing, ſtrangling, or ſhooting, can either extenuate or enhance the guilt; unleſs where, as in the caſe of poiſoning, it carries with it internal evidence of cool and deliberate malice. But the benignity of the law hath conſtrued the ſtatute ſo favourably in behalf of the ſubject, and ſo ſtrictly when againſt him, that the offence of ſtabbing now ſtands almoſt upon the ſame footing as it did at the common law. Thus, (not to repeat the caſes mentioned under MANSLAUGHTER, of ſtabbing an adultereſs, &c. which are barely manſlaughter, as at common law), in the conſtruction of this ſtatute it hath been doubted, whether, if the deceaſed had ſtruck at all before the mortal blow given, this does not take it out of the ſtatute, tho' in the preceding quarrel the ſtabber had given the firſt blow; and it ſeems to be the better opinion, that this is not within the ſtatute. Alſo it hath been reſolved, that the killing a man, by throwing a hammer or other weapon, is not within the ſtatute; and whether a ſhot with a piſtol be ſo or not is doubted. But if the party ſlain had a cudgel in his hand, or had thrown a pot or a bottle, or diſcharged a piſtol at the party ſtabbing, this is a ſufficient reaſon for having a weapon drawn on his ſide within the words of the ſtatute.

Blackſt. Comment. vol. iv. p. 193.

STACHYS, in botany: A genus of plants belonging to the claſs of *didynamia*, and order of *gymnoſpermia*; and in the natural ſyſtem arranged under the 42d order, *Verticillatæ*. The upper lip of the corolla is arched; the lower lip reflexed, and the larger intermediate lacinia is marginated. The ſtamina, after ſhedding the farina, are bent towards the ſides. There are 17 ſpecies, the ſylvatica, paluſtris, alpina, germanica, lanata, cretica, glutinoſa, orientalis, palæſtina, maritima, æthiopica, hirta, canarienſis, recta, annua, and arvenſis. Four only are natives of Britain.

1. *Sylvatica*, hedge-nettle. The plant is hairy all over, erect, a yard high, and branched; the hairs are jointed. The flowers are of a deep red colour, ſix or eight in a whirl, which terminates in a long ſpike deſtitute of leaves. The leaves are heart-ſhaped, and grow on footſtalks. The whole plant has a ſtrong fetid ſmell. It grows commonly in woods and ſhady places, and flowers in July or Auguſt. 2. *Paluſtris*, clown's all-heal. The roots are white and tuberous. The ſtalk is branched at the bottom, and two or three feet high. The flowers are red or purple, from ſix to ten in a whirl, ending in a long ſpike. The leaves are ſeſſile, narrow, pointed, and in part ſurrounding the ſtem. This plant has a fetid ſmell and bitter taſte, and is reckoned a good vulnerary. It grows on the ſides of rivers and lakes, in low moiſt grounds, and ſometimes in corn-fields. 3. *Germanica*, baſe hore-hound. The ſtem is downy, and about two feet high. The leaves are white, downy, wrinkled, and indented. The flowers are white, purpliſh within, and grow in multiflorous whirls. It grows in England. 4. *Arvenſis*, corn-ſtachys, petty iron-wort, or all-heal. The ſtalk is 10 or 12 inches high, ſquare, branched, and hairy. The leaves are heart-ſhaped, obtuſe, bluntly ſerrated, and leſs hairy. The calyx is hairy and ſeſſile, and deeply divided into five acute dents of equal length. The flowers are fleſh-coloured, and grow from three to ſix in a whirl. The lower lip is trifid; the middle ſegment ſpotted with red, but not emarginated according to the character of the genus. It is frequent in corn-fields, and grows from June to Auguſt.

Stadium, Stadtholder.

STADIUM, an ancient Greek long meaſure, containing 125 geometrical paces, or 625 Roman feet, correſponding to our furlong. The word is ſaid to be formed from the Greek word στασις "a ſtation," or ἱστημι "to ſtand," becauſe it is reported that Hercules having run a ſtadium at one breath, ſtood ſtill at the end of it. The Greeks uſually meaſured diſtances by ſtadia, which they called σταδιασμος. Stadium alſo ſignified the courſe on which their races were run.

STADTHOLDER, the principal magiſtrate or governor of the Seven United Provinces. This office is now aboliſhed by the republican influence of France; but as the prince of Orange is in alliance with this country, our readers will probably not be ill pleaſed with a ſhort account of his ſeveral powers and claims. To render that account the more intelligible, we ſhall trace the office of Stadtholder from its origin.

The Seven Provinces of the Low Countries were long governed by princes inveſted with the ſovereignty, though limited in their powers, and under various titles; as *Counts of Holland*, *Dukes of Guelder*, *Biſhop of Utrecht*, &c. When theſe countries fell to the princes of the houſe of Burgundy, and afterwards to thoſe of Auſtria, who had many other dominions, the abſence of the ſovereign was ſupplied by a ſtadtholder or governor, veſted with very ample powers. Theſe ſtadtholders or lieutenants had the adminiſtration of the government, and preſided in the courts of juſtice, whoſe juriſdiction was not at that time confined merely to the trial of cauſes, but extended to affairs of ſtate. The ſtadtholders ſwore allegiance to the princes at their inauguration, jointly with the ſtates of the provinces they governed. They likewiſe took an oath to the ſtates, by which they promiſed to maintain their fundamental laws and privileges.

It was upon this footing that William the Firſt, prince of Orange, was made governor and lieutenant-general of Holland, Zealand, and Utrecht, by Philip the Second, upon his leaving the Low Countries to go into Spain. The troubles beginning ſoon after, this prince found means to bring about an union, in 1576, between Holland and Zealand; the ſtates of which two provinces put into his hands, as far as was in their power, the ſovereign authority (for ſo long time as they ſhould remain in war and under arms), upon the ſame footing as Holland had intruſted him with in the year before. In 1581 the ſame authority was again renewed to him by Holland, as it was ſoon after by Zealand likewiſe; and in 1584, being already elected count of Holland, upon certain conditions he would have been formally inveſted with the ſovereignty, had not a wretch, hired and employed by the court of Spain, put an end to his life by a horrid aſſaſſination.

In the preamble of the inſtruments by which the ſtates in 1581 conferred the ſovereign authority upon prince William the Firſt, we find theſe remarkable words, which are there ſet down as fundamental rules: "That all republics and communities ought to preſerve, maintain, and fortify themſelves by unanimity; which being impoſſible to be kept up always among ſo

Stadtholder.

many members, often differing in inclinations and sentiments, it is consequently necessary that the government should be placed in the hands of one single chief magistrate." Many good politicians, and the greatest part of the inhabitants of these provinces, have, since the establishment of the republic, looked upon the stadtholderian government as an essential part of her constitution; nor has she been without a stadtholder but twice, that is to say, from the end of 1650 to 1672, and again from March 1702 till April 1747. The provinces of Friesland and Groningen, with Ommelands, have always had a stadtholder without interruption: their instructions, which are now no longer in force, may be seen in Aitzema; but formerly the powers of the stadtholder of these provinces were confined within narrower bounds, and till William the Fourth there was no stadtholder of the seven provinces together.

The stadtholder cannot declare war nor make peace, but he has, in quality of captain-general of the union, the command in chief of all the forces of the state (A); and military persons are obliged to obey him in every thing that concerns the service. He is not limited by instructions, but he has the important power of giving out orders for the march of troops, and the disposition of all matters relative to them. He not only directs their marches, but provides for the garrisons, and changes them at pleasure. All military edicts and regulations come from him alone; he constitutes and authorizes the high council of war of the United Provinces, and, as captain-general of every province, disposes of all military offices, as far as the rank of colonel inclusively. The higher posts, such as those of velt-marshals, generals, lieutenant-generals, major-generals, are given by the states-general, who choose the persons recommended by his highness. He makes the governors, commandants, &c. of towns and strong places of the republic, and of the barrier. The persons nominated present their instruments of appointment to their high mightinesses, who provide them with commissions. The states-general have likewise great regard to the recommendation of the prince stadtholder in the disposition of those civil employments which are in their gift.

The power of the stadtholder as high-admiral, extends to every thing that concerns the naval force of the republic, and to all the other affairs that are here within the jurisdiction of the admiralty. He presides at these boards either in person or by his representatives; and as chief of them all in general, and of every one in particular, he has power to make their orders and instructions be observed by themselves and others. He bestows the posts of lieutenant-admiral, vice-admiral, and rear-admiral, who command under him; and he makes likewise post-captains.

The stadtholder grants likewise letters of grace, pardon, and abolition, as well for the crime called *Communia Delicta*, as for military offences. In Holland and Zealand these letters are made out for crimes of the first sort, in the name of the states, with the advice of his highness. In military offences he consults the high council of war, and upon the *communia delicta* he takes the advice of the courts of justice, of the counsellors, committees of the provinces, of the council of state, and the tribunals of justice in the respective towns, according to the nature of the case.

In the provinces of Holland and Zealand, the stadtholder elects the magistrates of the towns annually, out of a double number that are returned to him by the towns themselves.

When any of those offices become vacant, which, at the time there was no governor, were in the disposal of the states of Holland, or as formerly in that of the chamber of accounts, the stadtholder has his choice of two, or, in some cases, of three candidates, named by their noble and great mightinesses. He chooses likewise the counsellors, inspectors of the dykes of Rynland, Delfland, and Scheeland, out of three persons presented to him by the boards of the counsellors *inspectors*; which boards are of very ancient establishment in Holland.

His highness presides in the courts of Holland, and in the courts of justice of the other provinces; and his name is placed at the head of the proclamations and acts, called in Dutch *Mandamenten*, or *Provisien van Justitie*. In Overyssel and in the province of Utrecht the possessors of fiefs hold of the prince stadtholder. He is supreme curator of the universities of Guelder, Friesland, and Groningen; grand forester and grand veneur in Guelder, in Holland, and other places. In the province of Utrecht, his highness, by virtue of the regulation of 1674, disposes of the provostships and other benefices which remain to the chapters, as also of the canonical prebends that fall in the months which were formerly the papal months.

By the first article of the council of state of the United Provinces, the stadtholder is the first member of it, and has a right of voting there, with an appointment of 25,000 guilders a-year. He assists also as often as he thinks it for the service of the state, at the deliberations of the states-general, to make propositions to them, and sometimes also at the conferences which the deputies of their high mightinesses hold in their different committees, in consequence of their standing orders. He likewise assists at the assemblies of the states of each particular province, and at that of the counsellors committees. In Guelder, Holland, and Utrecht, his highness has a share of the sovereignty, as chief or president of the body of nobles; and in Zealand, where he possesses the marquisate of Veer and Flushing, as first noble, and representing the whole nobility. In his absence he has in Zealand his representatives, who have the first place and the first voice in all the councils, and the first of whom is always first deputy from the province to the assembly of their high mightinesses.

In 1749 the prince stadtholder was created by the states.

(A) In times of war, however, the states have always named deputies for the army, to accompany the stadtholders in the field, and to serve them as counsellors in all their enterprises, particularly in the most important affairs, such as giving battle, or undertaking a siege, &c. This was always practised till the accession of king William the Third to the crown of Great Britain, and after his death was continued with regard to the general in chief of the army of the republic. In 1747 and 1748 there were likewise deputies with the army, but with more limited power.

Staehelina || Staffa.

ſtates-general, governor-general and ſupreme director of the Eaſt and Weſt India companies; dignities which give him a great deal of authority and power, and which had never been conferred upon any of his predeceſſors, nor have they hitherto been made hereditary. He has his repreſentatives in the ſeveral chambers of the company, and chooſes their directors out of a nomination of three qualified perſons. The prince enjoyed this prerogative in Zealand from the time of his elevation to the ſtadtholderate.

The revenues of the ſtadtholderate of the ſeven United Provinces are reckoned (including the 25,000 guilders which the prince enjoys annually as the firſt member of the council of ſtate, and what he has from the India company's dividends) to amount to 300,000 guilders a year. As captain-general of the union, his ſerene highneſs has 120,000 guilders *per annum*, beſides 24,000 from Frieſland, and 12,000 from Groningen, in quality of captain-general of thoſe provinces. In times of war the ſtate allows extraordinary ſums to the captain-general for the expence of every campaign.

To all theſe powers and privileges the prince of Orange has a legal and conſtitutional right; but he has been diveſted of them by a faction which ſeems determined to ſell to the cruel and arbitrary republic of France that country which his anceſtors redeemed from Auſtrian ſlavery, at the hazard of loſing every thing dear to them but liberty and honour.

STÆHELINA, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and order of *polygamia æqualis*; and in the natural ſyſtem arranged under the 49th order, *Compoſitæ*. The receptacle is paleaceous, the chaff being very ſhort; the pappus is branchy, and the antheræ caudated. There are eight ſpecies, the gnaphaloides, dubia, arboreſcens, fruticoſa, ilicifolia, corymboſa, chamæpeuce, and imbricata.

STAFF, an inſtrument ordinarily uſed to reſt on in walking. The ſtaff is alſo frequently uſed as a kind of natural weapon both of offence and defence; and for ſeveral other purpoſes.

STAFF, a light pole erected in different parts of a *ſhip*, whereon to hoiſt and diſplay the colours.

The principal of theſe is reared immediately over the ſtern, to diſplay the enſign; another is fixed on the bowſprit to extend the jack; three more are erected at the three maſt heads, or formed by their upper ends, to ſhow the flag or pendant of the reſpective ſquadron or diviſion to which the ſhip is appropriated. See ENSIGN, MAST, JACK, and PENDANT.

STAFF, in military matters, conſiſts of a quarter-maſter-general, adjutant-general, and majors of brigade. The ſtaff properly exiſts only in time of war. See *Quarter-Maſter General*, &c.

Regimental STAFF, conſiſts in the adjutant, quarter-maſter, chaplain, ſurgeon, &c.

STAFF, in muſic, five lines, on which, with the intermediate ſpaces, the notes of a ſong or piece of muſic are marked.

*Fore-*STAFF. See *Fore-Staff*.

STAFFA, one of the Hebrides or Weſtern Iſlands of Scotland, remarkable for its baſaltic pillars. It was viſited by Sir Joſeph Banks, who communicated the following account of it to Mr Pennant.

"The little iſland of Staffa lies on the weſt coaſt of Mull, about three leagues north-eaſt from Iona, or I-columbkill: its greateſt length is about an Engliſh mile, and its breadth about half a one. On the weſt ſide of the iſland is a ſmall bay where boats generally land; a little to the ſouthward of which the firſt appearance of pillars are to be obſerved: they are ſmall; and inſtead of being placed upright, lie down on their ſides, each forming a ſegment of a circle. From thence you paſs a ſmall cave, above which the pillars, now grown a little larger, are inclining in all directions: in one place in particular, a ſmall maſs of them very much reſembles the ribs of a ſhip. From hence having paſſed the cave, which, if it is not low-water, you muſt do in a boat, you come to the firſt ranges of pillars, which are ſtill not above half as large as thoſe a little beyond. Over againſt this place is a ſmall iſland, called in Erſe *Boo-ſha-la*, ſeparated from the main by a channel not many fathoms wide. This whole iſland is compoſed of pillars without any ſtratum above them; they are ſtill ſmall, but by much the neateſt formed of any about the place.

Staffa.

"The firſt diviſion of the iſland, for at high water it is divided into two, makes a kind of a cone, the pillars converging together towards the centre: on the other they are in general laid down flat: and in the front next to the main, you ſee how beautifully they are packed together, their ends coming out ſquare with the bank which they form. All theſe have their tranſverſe ſections exact, and their ſurfaces ſmooth; which is by no means the caſe with the large ones, which are cracked in all directions. I much queſtion, however, if any part of this whole iſland of Boo-ſha-la is two feet in diameter.

"The main iſland oppoſite to Boo-ſha-la, and farther towards the north-weſt, is ſupported by ranges of pillars pretty erect, and, though not tall (as they are not uncovered to the baſe), of large diameters; and at their feet is an irregular pavement, made by the upper ſides of ſuch as have been broken off, which extends as far under water as the eye can reach. Here the forms of the pillars are apparent: theſe are of three, four, five, ſix, and ſeven ſides; but the number of five and ſix are by much the moſt prevalent. The largeſt I meaſured was of ſeven; it was four feet five inches in diameter.

"The ſurfaces of theſe large pillars, in general, are rough and uneven, full of cracks in all directions; the tranſverſe figures in the upright ones never fail to run in their true directions. The ſurfaces upon which we walked were often flat, having neither concavity nor convexity; the larger number, however, were concave, though ſome were very evidently convex. In ſome places, the interſtices within the perpendicular figures were filled up with a yellow ſpar: in one place, a vein paſſed in among the maſs of pillars, carrying here and there ſmall threads of ſpar. Though they were broken and cracked through in all directions, yet their perpendicular figures might eaſily be traced: from whence it is eaſy to infer, that whatever the accident might have been that cauſed the diſlocation, it happened after the formation of the pillars.

"From hence proceeding along ſhore, you arrive at Fingal's cave. Its dimenſions I have given in the form of a table:

Staffa.

	Feet.	In.
Length of the cave from the rock without,	371	6
From the pitch of the arch, -	250	0
Breadth of ditto at the mouth, -	53	7
At the farther end, - -	20	0
Height of the arch at the mouth, -	117	6
At the end, - -	70	0
Height of an outside pillar, -	39	6
Of one at the north-west corner, -	54	0
Depth of water at the mouth, -	18	0
At the bottom, - -	9	0

"The cave runs into the rock in the direction of north-east by east by the compass.

"Proceeding farther to the north-west, you meet with the highest ranges of pillars; the magnificent appearance of which is past all description. Here they are bare to their very bases, and the stratum below them is also visible: in a short time, it rises many feet above the water, and gives an opportunity of examining its quality. Its surface is rough, and has often large lumps of stone sticking in it as if half immersed: itself, when broken, is composed of a thousand heterogeneous parts, which together have very much the appearance of a lava: and the more so, as many of the lumps appear to be of the very same stone of which the pillars are formed. This whole stratum lies in an inclined position, dipping gradually towards the south east. As hereabouts is the situation of the highest pillars, I shall mention my measurements of them, and the different strata in this place, premising, that the measurements were made with a line, held in the hand of a person who stood at the top of the cliff, and reaching to the bottom; to the lower end of which was tied a white mark, which was observed by one who staid below for the purpose: when this mark was set off from the water, the person below noted it down, and made signal to him above, who made then a mark in his rope: whenever this mark passed a notable place, the same signal was made, and the name of the place noted down as before: the line being all hauled up, and the distances between the marks measured and noted down, gave, when compared with the book kept below, the distances, as for instance in the cave:

"N° 1. in the book below, was called from the water to the foot of the first pillar in the book above; n° 1. gave 36 feet 8 inches, the highest of that ascent, which was composed of broken pillars.

"N° 1. Pillar at the west corner of Fingal's cave.

	Feet.	In.
1 From the water to the foot of the pillar,	12	10
2 Height of the pillar, - -	37	3
3 Stratum above the pillar, - -	66	9
"N° 2. Fingal's cave.		
1 From the water to the foot of the pillar,	36	8
2 Height of the pillar, - -	39	6
3 From the top of the pillar to the top of the arch, - - -	31	4
4 Thickness of the stratum above, -	34	4
By adding together the three first measurements, we got the height of the arch from the water, - - - -	117	6
"N° 3. Corner pillar to the westward of Fingal's cave.		
Stratum below the pillar of lava-like matter,	11	0
Length of pillar, - -	54	0
Stratum above the pillar - -	61	6
"N° 4. Another pillar to the westward.		
Stratum below the pillar, - -	17	1
Height of the pillar, - -	50	0
Stratum above, - - -	51	1
"N° 5. Another pillar farther to the westward.		
Stratum below the pillar, - -	19	8
Height of the pillar, - -	55	1
Stratum above, - - -	54	7

Staffa || Staffordshire.

"The stratum above the pillars, which is here mentioned, is uniformly the same, consisting of numberless small pillars, bending and inclining in all directions, sometimes so irregularly that the stones can only be said to have an inclination to assume a columnar form; in others more regular, but never breaking into or disturbing the stratum of large pillars, whose tops everywhere keep an uniform and regular line.

"Proceeding now along the shore round the north end of the island, you arrive at *Oua na scarve*, or the Corvorant's Cave. Here the stratum under the pillars is lifted up very high; the pillars above it are considerably less than those at the north-west end of the island, but still very considerable. Beyond is a bay, which cuts deep into the island, rendering it in that place not more than a quarter of a mile over. On the sides of this bay, especially beyond a little valley, which almost cuts the island into two, are two stages of pillars, but small; however, having a stratum between them exactly the same as that above them, formed of innumerable little pillars, shaken out of their places, and leaning in all directions.

"Having passed this bay, the pillars totally cease; the rock is of a dark-brown stone, and no signs of regularity occur till you have passed round the south-east end of the island (a space almost as large as that occupied by the pillars), which you meet again on the west side, beginning to form themselves irregularly, as if the stratum had an inclination to that form, and soon arrive at the bending pillars where I began.

"The stone of which the pillars are formed, is a coarse kind of basaltes, very much resembling the Giant's Causeway in Ireland, though none of them are near so neat as the specimens of the latter which I have seen at the British Museum; owing chiefly to the colour, which in ours is a dirty brown, in the Irish a fine black; indeed the whole production seems very much to resemble the Giant's Causeway."

STAFFORD, the county town of Staffordshire, in W. Long. 2. 0. N. Lat. 53. 0. It stands on the river Sow, has two parish churches, a fine square market-place, and a flourishing cloth manufacture. It sends two members to parliament, and is 135 miles from London.

STAFFORDSHIRE, a county of England, bounded on the south by Worcestershire, by Cheshire and Derbyshire on the north, by Warwickshire and Derbyshire on the east, and Shropshire and Cheshire on the west. The length is reckoned 62 miles, the breadth 33, and the circumference 180. It contains 5 hundreds, 150 parishes, 810,000 acres, and 18 market towns. The air, except in those parts that are called the Moorlands and Woodlands, and about the mines, is good, especially upon the hills, where it is accounted very

Staffordshire || Stage.

very fine. The ſoil in the northern mountainous parts is not fertile; but in the middle, where it is watered by the Trent, the third river in England, it is both fruitful and pleaſant, being a mixture of arable and meadow grounds. In the ſouth, it abounds not only with corn, but with mines of iron and pits of coal. The principal rivers of this county, beſides the Trent, which runs almoſt thro' the middle of it, and abounds with ſalmon, are the Dove and Tame, both of which are well ſtored with fiſh. In this county are alſo a great many lakes, or meres and pools, as they are called; which, having ſtreams either running into them or from them, cannot be ſuppoſed to be of any great prejudice to the air; they yield plenty of fiſh. In divers parts of the county are medicinal waters, impregnated with different ſorts of minerals, and conſequently of different qualities and virtues; as thoſe at Hints and Breſsford-houſe, which are mixed with bitumen; thoſe at Ingeſtre, Codſalwood, and Willough-bridge park, which are ſulphureous. Of the ſaline kind are the Brine-pits at Chertley, Epſom, Penſnet-cloſe, of which very good ſalt is made. There is a well at Newcaſtle-under-Line that is ſaid to cure the king's evil; another called *Elder-well* near Blemhill, ſaid to be good for ſore eyes; and a third called the *Spa*, near Wolverhampton.

Great flocks of ſheep are bred in this county, eſpecially in the moorlands, or mountains of the northern part of it; but the wool is ſaid to be ſomewhat coarſer than that of many other counties. Of this wool, however, they make a variety of manufactures, particularly felts. In the low grounds along the rivers are rich paſtures for black cattle; and vaſt quantities of butter and cheeſe are made. In the middle and ſouthern parts not only grain of all kinds, but a great deal of hemp and flax are raiſed. This county produces alſo lead, copper, iron; marble, alabaſter, millſtones, limeſtone; coal, ſalt, and marles of ſeveral ſorts and colours; brick-earth, fullers earth, and potters-clay§, particularly a ſort uſed in the glaſs manufacture at Amblecot, and ſold at ſeven-pence a buſhel; tobacco pipe-clay; a ſort of reddiſh earth called *ſlip*, uſed in painting divers veſſels; red and yellow ochres; fire-ſtones for hearths of iron furnaces, ovens, &c.; iron-ſtones of ſeveral ſorts; blood-ſtones, or hæmatites, found in the brook Tent, which, when wet a little, will draw red lines like ruddle; quarry-ſtones, and grind-ſtones. For fuel the county is well ſupplied with turf, peat, and coal of ſeveral ſorts, as cannel coal, peacock coal, and pit-coal. The peacock-coal is ſo called, becauſe, when turned to the light, it diſplays all the colours of the peacock's tail; but it is fitter for the forge than the kitchen. Of the pit-coal there is an inexhauſtible ſtore: it burns into white aſhes, and leaves no ſuch cinder as that of the Newcaſtle coal. It is not uſed for malting till it is charred, and in that ſtate it makes admirable winter-fuel for a chamber.

§ See STONE-*Ware*.

This county is in the dioceſe of Litchfield and Coventry, and the Oxford circuit. It ſends ten members to parliament; namely, two for the county, two for the city of Litchfield, two for Stafford, two for Newcaſtle-under-Line, and two for Tamworth.

STAG, in zoology. See CERVUS.

STAG-Beetle. See LUCANUS.

STAGE, in the modern drama, the place of action and repreſentation included between the pit and the ſcenes, and anſwering to the proſcenium or pulpitum of the ancients. See PLAYHOUSE and THEATRE.

Staggers || Stalagmitis.

STAGGERS. See FARRIERY, § xiii.

STAHL (George Erneſt), an eminent German chemiſt, was born in Franconia in 1660, and choſen profeſſor of medicine at Hall, when a univerſity was founded in that city in 1694. The excellency of his lectures while he filled that chair, the importance of his various publications, and his extenſive practice, ſoon raiſed his reputation to a very great height. He received an invitation to Berlin in 1716, which having accepted, he was made counſellor of ſtate and phyſician to the king. He died in 1734, in the 75th year of his age. Stahl is without doubt one of the greateſt men of which the annals of medicine can boaſt: his name marks the commencement of a new and more illuſtrious era in chemiſtry. He was the author of the doctrine of phlogiſton, which, though now completely overturned by the diſcoveries of Lavoiſier and others, was not without its uſe; as it ſerved to combine the ſcattered fragments of former chemiſts into a ſyſtem, and as it gave riſe to more accurate experiments and a more ſcientific view of the ſubject, to which many of the ſubſequent diſcoveries were owing. This theory maintained its ground for more than half a century, and was received and ſupported by ſome of the moſt eminent men which Europe has produced; a ſufficient proof of the ingenuity and the abilities of its author. He was the author alſo of A Theory of Medicine, founded upon the notions which he entertained of the abſolute dominion of mind over body; in conſequence of which, he affirmed, that every muſcular action is a voluntary act of the mind, whether attended with conſciouſneſs or not. This theory he and his followers carried a great deal too far, but the advices at leaſt which he gives to attend to the ſtate of the mind of the patient are worthy of the attention of phyſicians.

His principal works are, 1. *Experimenta et Obſervationes Chemicæ et Phyſicæ*, Berlin, 1731, 8vo. 2. *Diſſertationes Medicæ*, Hall, 2 vols 4to. This is a collection of theſes. 3. *Theoria Medica vera*, 1737, 4to. 4. *Opuſculum Chymico-phyſico medicum*, 1740, 4to. 5. A Treatiſe on Sulphur, both Inflammable and Fixed, written in German. 6. *Negotium Otioſum*, Hall, 1720, 4to. It is in this treatiſe chiefly that he eſtabliſhes his ſyſtem concerning the action of the ſoul upon the body. 7. *Fundamenta Chymicæ Dogmaticæ et Experimentalis*, Nuremberg, 1747, 3 vols 4to. 8. A Treatiſe on Salts, written in German. 9. *Commentarium in Metallurgiam Beccheri*, 1723.

STAINING *or* COLOURING *of* BONE, HORN, MARBLE, PAPER, WOOD, &c. See theſe articles.

STAIRCASE, in architecture, an aſcent incloſed between walls, or a baluſtrade conſiſting of ſtairs or ſteps, with landing places and rails, ſerving to make a communication between the ſeveral ſtories of a houſe. See ARCHITECTURE, n° 89, &c.

STALACTITÆ, in natural hiſtory, cryſtalline ſpars formed into oblong, conical, round, or irregular bodies, compoſed of various cruſts, and uſually found hanging in form of iſicles from the roofs of grottoes, &c.

STALAGMITIS, in botany: A genus of the *monæcia* order, belonging to the *polygamia* claſs of plants; and in the natural method ranking under the 38th order, *Tricoccæ*. The calyx is either quadriphyllous or

Stale ‖ Stamina.

hexaphyllous; the corolla conſiſts of four or of ſix petals: the receptacle is fleſhy, and ſomewhat ſquare-ſhaped; the filaments about 30. In the hermaphrodite flower the *ſtylus* is ſhort, thick, and erect; the fruit is a berry of a globular ſhape, unilocular, and crowned with the *ſtylus* and *ſtigma*: they contain three oblong jointed triangular ſeeds. Of this there is only one ſpecies, viz. the *Cambogioides*, a native of the Eaſt Indies and of the warmer parts of America. From this plant is obtained the gutta cambogia, or gum gamboge of the ſhops. See GAMBOGE.

Till very lately botaniſts were at a loſs for the true nature of the plant which yields this gum. Koenig, a native of Ireland, and an excellent botaniſt, travelled over a great part of India, and collected a great number of new plants, and among the reſt the ſtalagmitis. Theſe he bequeathed to Sir Joſeph Banks preſident of the Royal Society.

STALE, among ſportſmen, a living fowl put in a place to allure ad bring others where they may be taken. For want of theſe, a bird ſhot, his entrails taken out, and dried in an oven in his feathers, with a ſtick thruſt through to keep it in a convenient poſture, may ſerve as well as a live one.

STALE is alſo a name for the urine of cattle.

ANIMATED STALK. This remarkable animal was found by Mr Ives at Cuddalore: and he mentions ſeveral kinds of it; ſome appearing like dry ſtraws tied together, others like graſs; ſome have bodies much larger than others, with the addition of two ſcaly imperfect wings; their neck is no bigger than a pin, but twice as long as their bodies; their heads are like thoſe of an hare and their eyes vertical and very briſk. They live upon flies, and catch theſe inſects very dexterouſly with the two fore-feet, which they keep doubled up in three parts cloſe to their head, and dart out very quick on the approach of their prey; and when they have caught it, they eat it very voraciouſly, holding it in the ſame manner as a ſquirrel does its food. On the outer joints of the fore-feet are ſeveral very ſharp hooks for the eaſier catching and holding of their prey; while, with the other feet, which are four in number, they take hold of trees or any other thing, the better to ſurpriſe whatever they lie in wait for. They drink like a horſe, putting their mouths into the water. Their excrements, which are very white, are almoſt as large as the body of the animal, and as the natives ſay, dangerous to the eyes.

STALLION, or STONE-HORSE, in the manege, an horſe deſigned for the covering of mares, in order to propagate the ſpecies. See EQUUS.

STAMFORD, an ancient town of Lincolnſhire in England; ſeated on the river Welland, on the edge of Northamptonſhire. It is a large handſome place, containing ſix pariſh-churches, ſeveral good ſtreets, and fine buildings. It had formerly a college, the ſtudents of which removed to Brazen-Noſe college in Oxford. It has no conſiderable manufactories, but deals chiefly in malt. W. Long. 0. 31. N. Lat. 52. 42.

STAMINA, in botany, are thoſe upright filaments which, on opening a flower, we find within the corolla ſurrounding the piſtillum. According to Linnæus, they are the male organs of generation, whoſe office it is to prepare the pollen. Each ſtamen conſiſts of two diſtinct parts, viz. the FILAMENTUM and the ANTHERA.

Stamina ‖ Standard.

STAMINA, in the animal body, are deſined to be thoſe ſimple original parts which exiſted firſt in the embryo or even in the ſeed; and by whoſe diſtinction, augmentation, and accretion by additional juices, the animal body at its utmoſt bulk is ſuppoſed to be formed.

STAMP-DUTIES, a branch of the perpetual revenue. See REVENUE.

In Great Britain there is a tax impoſed upon all parchment and paper, whereon any legal proceedings or private inſtruments of almoſt any nature whatſoever are written; and alſo upon licences for retailing wines, of all denominations; upon all almanacs, newſpapers, advertiſements, cards, dice, &c. Theſe impoſts are very various; being higher or lower, not ſo much according to the value of the property transferred, as according to the nature of the deed. The higheſt do not exceed ſix pounds upon every ſheet of paper or ſkin of parchment; and theſe high duties fall chiefly upon grants from the crown, and upon certain law proceedings, without any regard to the value of the ſubject. There are in Great Britain no duties on the regiſtration of deeds or writings, except the fees of the officers who keep the regiſter; and theſe are ſeldom more than a reaſonable recompenſe for their labour. The crown derives no revenue from them. *Smith's Wealth of Nations*, vol. iii.

The ſtamp-duties conſtitute a tax which, though in ſome inſtances it may be heavily felt, by greatly increaſing the expence of all mercantile as well as legal proceedings, yet (if moderately impoſed) is of ſervice to the public in general, by authenticating inſtruments, and rendering it much more difficult than formerly to forge deeds of any ſtanding; ſince, as the officers of this branch of the revenue vary their ſtamps frequently, by marks perceptible to none but themſelves, a man that would forge a deed of King William's time, muſt know and be able to counterfeit the ſtamp of that date alſo. In France and ſome other countries the duty is laid on the contract itſelf, not on the inſtrument in which it is contained; as, with us too in England (beſides the ſtamps on the indentures), a tax is laid, by ſtatute 8 Ann. c. 9. on every apprentice-fee; of 6 d. in the pound if it be 50 l. or under, and 1 s. in the pound if a greater ſum: but this tends to draw the ſubject into a thouſand nice diſquiſitions and diſputes concerning the nature of his contract, and whether taxable or not; in which the farmers of the revenue are ſure to have the advantage. Our general method anſwers the purpoſes of the ſtate as well, and conſults the eaſe of the ſubject much better. The firſt inſtitution of the ſtamp-duties was by ſtatute 5 and 6 W. and M. c. 21. and they have ſince, in many inſtances, been increaſed to five times their original amount.

STANCHION, or STANCHIONS, a ſort of ſmall pillars of wood or iron uſed for various purpoſes in a ſhip; as to ſupport the decks, the quarter-rails, the nettings, the awnings, &c. The firſt of theſe are two ranges of ſmall columns fixed under the beams, throughout the ſhip's length between decks; one range being on the ſtarboard and the other on the larboard ſide of the hatchways. They are chiefly intended to ſupport the weight of the artillery.

STAND, in commerce, a weight from two hundred and an half to three hundred of pitch.

STANDARD, in war, a ſort of banner or flag,

Standard. Stanhope.

borne as a ſignal for the joining together of the ſeveral troops belonging to the ſame body.

STANDARD, in commerce, the original of a weight, meaſure, or coin, committed to the keeping of a magiſtrate, or depoſited in ſome public place, to regulate, adjuſt, and try the weights uſed by particular perſons in traffic. See MONEY.

STANHOPE (Philip Dormer, earl of Cheſterfield), was born in 1695, and educated in Trinity-hall, Cambridge; which place he left in 1714, when, by his own account, he was an abſolute pedant. In this character he went abroad, where a familiarity with good company ſoon convinced him he was totally miſtaken in almoſt all his notions: and an attentive ſtudy of the air, manner, and addreſs of people of faſhion, ſoon poliſhed a man whoſe predominant deſire was to pleaſe; and who, as it afterward appeared, valued exterior accompliſhments beyond any other human acquirement. While Lord Stanhope, he got an early ſeat in parliament; and in 1722, ſucceeded to his father's eſtate and titles. In 1728, and in 1745, he was appointed ambaſſador extraordinary and plenipotentiary to Holland: which high character he ſupported with the greateſt dignity; ſerving his own country, and gaining the eſteem of the ſtates-general. Upon his return from Holland, he was ſent lord-lieutenant of Ireland; and during his adminiſtration there, gave general ſatisfaction to all parties. He left Dublin in 1746, and in October ſucceeded the earl of Harrington as ſecretary of ſtate, in which poſt he officiated until February 6th 1748. Being ſeized with a deafneſs in 1752 that incapacitated him for the pleaſures of ſociety, he from that time led a private and retired life, amuſing himſelf with books and his pen; in particular, he engaged largely as a volunteer in a periodical miſcellaneous paper called *The World*, in which his contributions have a diſtinguiſhed degree of excellence. He died in 1773, leaving a character for wit and abilities that had few equals. He diſtinguiſhed himſelf by his eloquence in parliament on many important occaſions; of which we have a characteriſtic inſtance, of his own relating. He was an active promoter of the bill for altering the ſtyle; on which occaſion, as he himſelf writes in one of his letters to his ſon, he made ſo eloquent a ſpeech in the houſe, that every one was pleaſed, and ſaid he had made the whole very clear to them; "when (ſays he), God knows, I had not even attempted it. I could juſt as ſoon have talked Celtic or Sclavonian to them, as aſtronomy; and they would have underſtood me full as well." Lord Macclesfield, one of the greateſt mathematicians in Europe, and who had a principal hand in framing the bill, ſpoke afterwards, with all the clearneſs that a thorough knowledge of the ſubject could dictate; but not having a flow of words equal to Lord Cheſterfield, the latter gained the applauſe from the former, to the equal credit of the ſpeaker and the auditors. The high character Lord Cheſterfield ſupported during life, received no ſmall injury ſoon after his death, from a fuller diſplay of it by his own hand. He left no iſſue by his lady, but had a natural ſon, Philip Stanhope, Eſq; whoſe education was for many years a cloſe object of his attention, and who was afterward envoy extraordinary at the court of Dreſden, but died before him. When Lord Cheſterfield died, Mr Stanhope's widow publiſhed a courſe of letters, written by the father to the ſon, filled with inſtructions ſuitable to the different gradations of the young man's life to whom they were addreſſed. Theſe letters contain many fine obſervations on mankind, and rules of conduct: but it is obſervable that he lays a greater ſtreſs on exterior accompliſhments and addreſs, than on intellectual qualifications and ſincerity; and allows greater latitude to faſhionable pleaſures than good morals will juſtify, eſpecally in paternal inſtructions. Hence it is that a celebrated writer §, and of manners ſomewhat different from thoſe of the polite earl of Cheſterfield, is ſaid to have obſerved of theſe letters that "they inculcate only the morals of a whore, with the manners of a dancing-maſter." Stanhope. § Dr Johnſon.

STANHOPE (Dr George), an eminent divine, was born at Hertiſhorn in Derbyſhire, in the year 1660. His father was rector of that place, vicar of St Margaret's church in Leiceſter, and chaplain to the earls of Cheſterfield and Clare. His grandfather Dr George Stanhope was chaplain to James I. and Charles I.; had the chancellorſhip of York, where he was alſo a canon reſidentiary, held a prebend, and was rector of Weldrake in that county. He was for his loyalty driven from his home with eleven children; and died in 1644. Our author was ſent to ſchool, firſt at Uppingham in Rutland, then at Leiceſter; afterwards removed to Eaton; and thence choſen to King's college in Cambridge, in the place of W. Cleaver. He took the degree of B. A. in 1681; M. A. 1658; was elected one of the ſyndics for the univerſity of Cambridge, in the buſineſs of Alban Francis, 1687; miniſter of Quoi near Cambridge, and vice-proctor, 1688; was that year preferred to the rectory of Tring in Hertfordſhire, which after ſome time he quitted. He was in 1689 preſented to the vicarage of Lewiſham in Kent by Lord Dartmouth, to whom he had been chaplain, and tutor to his ſon. He was alſo appointed chaplain to King William and Queen Mary, and continued to enjoy that honour under Queen Anne. He commenced D. D. July 5th 1697, performing all the offices required to that degree publicly and with great applauſe. He was made vicar of Deptford in 1703; ſucceeded Dr Hooper as dean of Canterbury the ſame year; and was thrice choſen prolocutor of the lower houſe of convocation. His uncommon diligence and induſtry, aſſiſted by his excellent parts, enriched him with a large ſtock of polite, ſolid, and uſeful learning. His diſcourſes from the pulpit were equally pleaſing and profitable; a beautiful intermixture of the cleareſt reaſoning with the pureſt diction, attended with all the graces of a juſt elocution. The good Chriſtian, the ſolid divine, and the fine gentleman, in him were happily united. His converſation was polite and delicate, grave without preciſeneſs, facetious without levity. His piety was real and rational, his charity great and univerſal, fruitful in acts of mercy, and in all good works. He died March 18th 1728, aged 68 years; and was buried in the chancel of the church at Lewiſham. The dean was twice married: 1. to Olivia Cotton, by whom he had one ſon and four daughters. His ſecond lady, who was ſiſter to Sir Charles Wager, ſurvived him, dying October 1ſt 1730, aged about 54. One of the dean's daughters was married to a ſon of biſhop Burnet. Biſhop Moore of Ely died the day before Queen Anne; who, it has been ſaid, deſigned our dean for that

Stanhope, Staniſlaus.

ſee when it ſhould become vacant. Dr Felton ſays, "The late dean of Canterbury is excellent in the whole. His thoughts and reaſoning are bright and ſolid. His ſtyle is juſt, both for the purity of the language and for the ſtrength and beauty of expreſſion; but the periods are formed in ſo peculiar an order of the words, that it was an obſervation, nobody could pronounce them with the ſame grace and advantage as himſelf." His writings, which are an ineſtimable treaſure of piety and devotion are, A Paraphraſe and Comment upon the Epiſtles and Goſpels, 4 vols, 1705, 8vo. Sermons at Boyle's Lectures, 1706, 4to. Fifteen Sermons, 1700, 8vo. Twelve Sermons on ſeveral Occaſions, 1727, 8vo. Thomas à Kempis 1696, 8vo. Epictetus's Morals, with Simplicius's Comment, and the Life of Epictetus, 1700, 8vo. Parſon's Chriſtian Directory, 1716, 8vo. Rochefoucault's Maxims, 1706, 8vo. A Funeral Sermon on Mr Richard Sare bookſeller, 1724; two editions 4to. Twenty Sermons, publiſhed ſingly between the years 1692 and 1724. Private Prayers for every Day in the Week, and for the ſeveral Parts of each Day; tranſlated from the Greek Devotions of Biſhop Andrews, with Additions, 1730. In his tranſlations, it is well known, Dr Stanhope did not confine himſelf to a ſtrict and literal verſion: he took the liberty of paraphraſing, explaining, and improving upon his author; as will evidently appear (not to mention any other work) by the ſlighteſt peruſal of St Auguſtine's Meditations, and the Devotions of Biſhop Andrews.

STANISLAUS (Leczinſki), king of Poland, was born at Leopold the 20th of Octocter 1677. His father was a poliſh nobleman, diſtinguiſhed by his rank and the important offices which he held, but ſtill more by his firmneſs and courage. Staniſlaus was ſent ambaſſador in 1704 by the aſſembly of Warſaw to Charles XII. of Sweden, who had conquered Poland. He was at that time 27 years old, was general of great Poland, and had been ambaſſador extraordinary to the Grand Signior in 1699. Charles was ſo delighted with the frankneſs and ſincerity of his deportment, and with the firmneſs and ſweetneſs which appeared in his countenance, that he offered him the crown of Poland, and ordered him to be crowned at Warſaw in 1705. He accompanied Charles XII. into Saxony, where a treaty was concluded with King Auguſtus in 1705, by which that prince reſigned the crown, and acknowledged Staniſlaus king of Poland. The new monarch remained in Saxony with Charles till 1707, when they returned into Poland and attacked the Ruſſians, who were obliged to evacuate that kingdom in 1708. But Charles being defeated by Peter the Great in 1709, Auguſtus returned into Poland, and being aſſiſted by a Ruſſian army, obliged Staniſlaus to retire firſt into Sweden, and afterwards into Turkey. Soon after he took up his reſidence at Weiſſenburg, a town in Alſace. Auguſtus diſpatched Sum his envoy to France to complain of this; but the duke of Orleans, who was then regent, returned this anſwer: "Tell your king, that France has always been the aſylum of unhappy princes." Staniſlaus lived in obſcurity till 1725, when Louis XV. eſpouſed the princeſs Mary his daughter. Upon the death of King Auguſtus in 1733, he returned to Poland in hopes of remounting the throne of that kingdom. A large party declared for him; but his competitor the young elector of Saxony, being ſupported by the Emperor Charles VI. and the Empreſs of Ruſſia, was choſen king, though the majority was againſt him. Dantzic, to which Staniſlaus had retired, was quickly taken, and the unfortunate prince made his eſcape in diſguiſe with great difficulty, after hearing that a price was ſet upon his head by the Ruſſians. When peace was concluded in 1736 between the Emperor and France, it was agreed that Staniſlaus ſhould abdicate the throne, but that he ſhould be acknowledged king of Poland and grand duke of Lithuania, and continue to bear theſe titles during life; that all his effects and thoſe of the queen his ſpouſe ſhould be reſtored; that an amneſty ſhould be declared in Poland for all that was paſt, and that every perſon ſhould be reſtored to his poſſeſſions, rights, and privileges: that the elector of Saxony ſhould be acknowledged king of Poland by all the powers who acceded to the treaty: that Staniſlaus ſhould be put in peacable poſſeſſion of the duchies of Lorrain and Bar; but that immediately after his death theſe duchies ſhould be united for ever to the crown of France. Staniſlaus ſucceeded a race of princes in Lorrain, who were beloved and regretted: and his ſubjects found their ancient ſovereigns revived in him. He taſted then the pleaſure which he had ſo long deſired, the pleaſure of making men happy. He aſſiſted his new ſubjects; he embelliſhed Nancy and Lunéville; he made uſeful eſtabliſhments; he founded colleges and built hoſpitals. He was engaged in theſe noble employments, when an accident occaſioned his death. His night-gown caught fire and burnt him ſo ſeverely before it could be extinguiſhed, that he was ſeized with a fever, and died the 23d of February 1766. His death occaſioned a public mourning: the tears of his ſubjects indeed are the beſt eulogium upon this prince. In his youth he had accuſtomed himſelf to fatigue, and had thereby ſtrengthened his mind as well as his conſtitution. He lay always upon a kind of mattreſs, and ſeldom required any ſervice from his domeſtics. He was temperate, liberal, adored by his vaſſals, and perhaps the only nobleman in Poland who had any friends. He was in Lorrain what he had been in his own country, gentle, affable, compaſſionate, treating his ſubjects like equals, participating their ſorrows and alleviating their misfortunes. He reſembled completely the picture of a philoſopher which he himſelf has drawn. "The true philoſopher (ſaid he) ought to be free from prejudices, and to know the value of reaſon: he ought neither to think the higher ranks of life of more value than they are, nor to treat the lower orders of mankind with greater contempt than they deſerve: he ought to enjoy pleaſures without being a ſlave to them, riches without being attached to them, honours without pride or vanity: he ought to ſupport diſgraces without either fearing or courting them: he ought to reckon what he poſſeſſes ſufficient for him, and to regard what he has not as uſeleſs: he ought to be equal in every fortune, always tranquil, always gay: he ought to love order, and to obſerve it in all his actions: he ought to be ſevere to himſelf, but indulgent to others: he ought to be frank and ingenuous without rudeneſs, polite without falſehood, complaiſant without baſeneſs: he ought to have the courage to diſregard every kind of glory, and to reckon as nothing even philoſophy itſelf." Such was Staniſlaus in every ſituation. His temper was affectionate.

Staniſlaus.

Staniſlaus ‖ Stannary.

ate. He told his treaſurer one day to put a certain officer on his liſt, to whom he was very much attached: "In what quality (ſaid the treaſurer) ſhall I mark him down?" "As my friend" (replied the monarch.) A young painter conceiving hopes of making his fortune if his talents were made known to Staniſlaus, preſented him with a picture, which the courtiers criticiſed ſeverely. The prince praiſed the performance, and paid the painter very generouſly: then turning to his courtiers, he ſaid, "Do ye not ſee, gentlemen, that this poor man muſt provide for his family by his abilities? if you diſcourage him by your cenſures, he is undone. We ought always to aſſiſt men; we never gain any thing by hurting them." His revenues were ſmall; but were we to judge of him by what he did, we ſhould probably reckon him the richeſt potentate in Europe. A ſingle inſtance will be ſufficient to ſhow the well judged economy with which his benevolent plans were conducted. He gave 18,000 crowns to the magiſtrates of Bar to be employed in purchaſing grain, when at a low price, to be ſold out again to the poor at a moderate rate when the price ſhould riſe above a certain ſum. By this arrangement (ſay the authors of *Dictionaire Hiſtorique*), the money increaſes continually, and its good effects may in a ſhort time be extended over the whole province.

He was a protector of the arts and ſciences: he wrote ſeveral works of philoſophy, politics, and morality, which were collected and publiſhed in France in 1765, in 4 vols, 8vo. under the title of *Oeuvres du Philoſophe Bienfaiſant*, "the works of the Benevolent Philoſopher."

STANITZAS, villages or ſmall diſtricts of the banks of the Don, inhabited by Coſſacs.

STANLEY (Thomas), a very learned Engliſh writer in the 17th century, was the ſon of Sir Thomas Stanley of Cumberlow-Green in Herefordſhire, knight. He was born at Cumberlow about 1644, and educated in his father's houſe, whence he removed to the univerſity of Cambridge. He afterwards travelled; and, upon his return to England, proſecuted his ſtudies in the Middle Temple. He married, when young, Dorothy, the eldeſt daughter of Sir James Engan of Flower, in Northamptonſhire. He wrote, 1. A volume of Poems. 2. Hiſtory of Philoſophy, and Lives of the Philoſophers. 3. A Tranſlation of Eſchylus, with a Commentary; and ſeveral other works. He died in 1678.

STANNARIES, the mines and works where tin is dug and purified; as in Cornwall, Devonſhire, &c.

STANNARY COURTS, in Devonſhire and Cornwall, for the adminiſtration of juſtice among the tinners therein. They are held before the lord-warden and his ſubſtitutes, in virtue of a privilege granted to the workers in the tin-mines there, to ſue and be ſued only in their own courts, that they may not be drawn from their buſineſs, which is highly profitable to the public, by attending their law-ſuits in other courts. The privileges of the tinners are confirmed by a charter, 33 Edw. I. and fully expounded by a private ſtatute, 50 Edw. III. which has ſince been explained by a public act, 16 Car. I. c. 15. What relates to our preſent purpoſe is only this: That all tinners and labourers in and about the ſtannaries ſhall, during the time of their working therein, *bona fide*, be privileged from ſuits of other courts, and be only pleaded in the ſtannary court in all matters, excepting pleas of land, life, and member. No writ of error lies from hence to any court in Weſtminſter-hall; as was agreed by all the judges, in 4 Jac. I. But an appeal lies from the ſteward of the court to the under-warden; and from him to the lord-warden; and thence to the privy-council of the prince of Wales, as duke of Cornwall, when he hath had livery or inveſtiture of the ſame. And from thence the appeal lies to the king himſelf, in the laſt reſort.

Blackſtone's Comment. vol. iii. p. 79 and 80.

Stannum ‖ Staphylinus.

STANNUM, TIN. See CHEMISTRY-*Index*, and TIN.

STANZA, in poetry, a number of lines regularly adjuſted to each other; ſo much of a poem as contains every variation of meaſure or relation of rhyme uſed in that poem.

STAPHYLEA, BLADDER-NUT, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *trigynia;* and in the natural ſyſtem arranged under the 23d order, *tribilatæ*. The calyx is quinquepartite. There are five petals. The capſules are three, inflated and joined together by a longitudinal future. The ſeeds are two, and are globoſe with a ſcar. There are two ſpecies, the pinnata and trifolia. The *pinnata*, or bladder-nut-tree, is a tall ſhrub or tree. The leaves are pinnated; the pinnæ are generally five, oblong, pointed, and notched round the edges. The flowers are white, and grow in whirls on long pendulous footſtalks. This plant flowers in June, and is frequent in hedges about Pontefract and in Kent. The *trifolia*, or three-leaved bladder-nut, is a native of Virginia.

STAPHYLINUS, a genus of animals belonging to the claſs of *inſectæ*, and order of *coleoptera*. The antennæ are moniliform; the feelers four in number; the elytra are not above half the length of the abdomen; the wings are folded up and concealed under the elytra; the tail or extremity of the abdomen is ſingle, is provided with two long veſicles which the inſect can ſhoot out or draw back at pleaſure. Gmelin enumerates 117 ſpecies, of which five only are natives of Great Britain; the murinus, maxilloſus, ruſus, riparius, chryſomelinus.

1. *Murinus*. The head is depreſſed. The colour is grey, clouded with black. The length is ſix lines. It lives among horſe-dung. 2. The *maxilloſus* is black, with aſh-coloured ſtripes, and jaws as long as the head. It inhabits the woods. 3. *Ruſus* is of an orange-colour; but the poſterior part of the elytra and abdomen is black, as are alſo the thighs at their baſe. 4. *Riparius* is of a reddiſh brown colour; but the elytra are azure-coloured; and the head, antennæ, and two laſt rings of the abdomen, are black. It is frequent on the banks of rivers in Europe. 5. *Chryſomelinus* is black; the thorax, elytra, and feet being teſtaceous. It is found in the north of Europe.

The inſects have a peculiarity to be met with in almoſt every ſpecies of this genus, which is, that they frequently turn up their tail, or extremity of the abdomen, eſpecially if you chance to touch them; in which caſe the tail is ſeen to riſe immediately, as if the inſect meant to defend itſelf by ſtinging. Yet that is not the place where the inſect's offenſive weapons are ſituated. Its tail has no ſting, but in recompenſe it bites and pinches ſtrongly with its jaws; and care muſt be taken, eſpecially in laying hold of the larger ſpecies. Their jaws are ſtrong, ſhoot out beyond the head, and are ſubſervient to the animal in ſeizing and deſtroying its

Barbut's Genera Inſectorum.

Staple, Star.

its prey. It feeds on all other insects it can catch: even frequently two staphylini of the same species bite and tear each other. Though this insect has very small elytra, yet its wings are large; but they are curiously folded up, and concealed under the elytra. The insect unfolds and expands them when he chooses to fly, which he does very lightly. Among the small species of this genus, there are several whose colours are lively and singularly intermingled.

Some of them are found upon flowers, but they chiefly inhabit the dung of cows. Their larvæ, which resemble them so much as to be scarce distinguishable, live in damp places under ground. They are by some called *Rove beetles*.

STAPLE, primarily signifies a public place or market, whither merchants, &c. are obliged to bring their goods to be bought by the people; as the Greve, or the places along the Seine, for sale of wines and corn, at Paris, whither the merchants of other parts are obliged to bring those commodities.

Formerly, the merchants of England were obliged to carry their wool, cloth, lead, and other like staple commodities of this realm, in order to expose them by wholesale; and these staples were appointed to be constantly kept at York, Lincoln, Newcastle upon Tyne, Norwich, Westminster, Canterbury, Chichester, Winchester, Exeter, and Bristol; in each whereof a public mart was appointed to be kept, and each of them had a court of the mayor of the staple, for deciding differences, held according to the law-merchant, in a summary way.

STAR, in astronomy, a general name for all the heavenly bodies, which, like so many brilliant studs, are dispersed throughout the whole heavens. The stars are distinguished, from the phenomena of their motion, &c. into fixed, and erratic or wandering stars: these last are again distinguished into the greater luminaries, viz. the sun and moon; the planets, or wandering stars, properly so called; and the comets; which have been all fully considered and explained under the article ASTRONOMY. As to the fixed stars, they are so called, because they seem to be fixed, or perfectly at rest, and consequently appear always at the same distance from each other.

Falling STARS, in meteorology, fiery meteors which dart through the sky in form of a star. See METEOR.

Twinkling of the STARS. See OPTICS, n° 21. *et seq.*

STAR, is also a badge of honour, worn by the knights of the garter, bath, and thistle. See GARTER.

Star of Bethlehem, in botany. See ORNITHOGALUM.

Court of STAR-CHAMBER, *(camera stellata)*, a famous, or rather infamous, English tribunal, said to have been so called either from a Saxon word signifying to *steer* or govern; or from its punishing the *crimen stellionatus*, or cosenage; or because the room wherein it sat, the old council-chamber of the palace of Westminster, (Lamb 148.) which is now converted into the lottery-office, and forms the eastern side of New Palace-yard, was full of windows; or, (to which Sir Edward Coke, 4 Inst. 66. accedes), because *haply* the roof thereof was at the first garnished with gilded *stars*. As all these are merely conjectures, (for no stars are now in the roof, nor are any said to have remained there so late as the reign of queen Elizabeth), it may be allowable to propose another conjectural etymology, as plausible perhaps as any of them. It is well known, that, before the banishment of the Jews under Edward I. their contracts and obligations were denominated in our ancient records *starra* or *starrs*, from a corruption of the Hebrew word, *shetar*, a covenant. (Tovey's *Angl. Judaic.* 32. Selden. tit. of hon. ii. 34. *Uxor Ebraic.* i. 14.) These starrs, by an ordinance of Richard the First, preserved by Hoveden, were commanded to be enrolled and deposited in chests under three keys in certain places; one, and the most considerable, of which was in the king's exchequer at Westminster: and no starr was allowed to be valid, unless it were found in some of the said repositories. *(Memorand. in Scac' P. 6. Edw.* I. prefixed to Maynard's year-book of Edw. II. fol. 8. Madox hist. exch. c. vii. § 4, 5, 6.) The room at the exchequer, where the chests containing these starrs were kept, was probably called the *star-chamber*; and, when the Jews were expelled the kingdom, was applied to the use of the king's council, sitting in their judicial capacity. To confirm this, the first time the star-chamber is mentioned in any record, it is said to have been situated near the receipt of the exchequer at Westminster: (the king's council, his chancellor, treasurer, justices, and other sages, were assembled *en la chaumbre des esteilles pres la resceipt al Westminster. Clauss.* 41 *Edw.* III. *m.* 13.) For in process of time, when the meaning of the Jewish *starrs* were forgotten, the word *star-chamber* was naturally rendered in law French, *la chaumbre des esteilles*, and in law Latin *camera stellata*; which continued to be the style in Latin till the dissolution of that court. Star. Blackst. Comment. vol. iv. p. 266.

This was a court of very ancient original; but new-modelled by statutes 3 Hen. VII. c. 1. and 21 Hen. VIII. c. 20. consisting of divers lords spiritual and temporal, being privy-counsellors, together with two judges of the courts of common-law, without the intervention of any jury. Their jurisdiction extended legally over riots, perjury, misbehaviour of sheriffs, and other notorious misdemeanors, contrary to the laws of the land. Yet this was afterwards (as lord Clarendon informs us) stretched "to the asserting of all proclamations and orders of state; to the vindicating of illegal commissions and grants of monopolies; holding for honourable that which pleased, and for just that which profited; and becoming both a court of law to determine civil rights, and a court of revenue to enrich the treasury: the council-table by proclamations enjoining to the people that which was not enjoined by the laws, and prohibiting that which was not prohibited; and the star-chamber, which consisted of the same persons in different rooms, censuring the breach and disobedience to those proclamations by very great fines, imprisonments, and corporal severities: so that any disrespect to any acts of state, or to the persons of statesmen, was in no time more penal, and the foundations of right never more in danger to be destroyed." For which reasons, it was finally abolished by statute 16 Car. I. c. 10. to the general joy of the whole nation. See *King's Bench.* There is in the British Museum (Harl. MSS. Vol. I. n° 126.) a very full, methodical, and accurate account of the constitution and course of this court, compiled by William Hudson of Gray's Inn, an eminent practitioner therein. A short account of the same, with

copies

Star, Starch.

copies of all its proceſs, may alſo be found in 18 Rym. Foed. 192, &c.

Star-Board, the right ſide of the ſhip when the eye of the ſpectator is directed forward.

Star-Fiſh. See Asterias.

Star-ſhot, a gelatinous ſubſtance frequently found in fields, and ſuppoſed by the vulgar to have been produced from the meteor called a *falling ſtar*: but, in reality, is the half-digeſted food of herons, ſea-mews, and the like birds; for theſe birds have been found, when newly ſhot, to diſgorge a ſubſtance of the ſame kind.

Star-Stone, in natural hiſtory, a name given to certain extraneous foſſil ſtones, in form of ſhort, and commonly ſomewhat crooked, columns compoſed of ſeveral joints, each reſembling the figure of a radiated ſtar, with a greater or ſmaller number of rays in the different ſpecies: they are uſually found of about an inch in length, and of the thickneſs of a gooſe-quill. Some of them have five angles or rays, and others only four; and in ſome the angles are equidiſtant, while in others they are irregularly ſo: in ſome alſo they are ſhort and blunt, while in others they are long, narrow, and pointed; and ſome have their angles very ſhort and obtuſe. The ſeveral joints in the ſame ſpecimen are uſually all of the ſame thickneſs; this, however, is not always the caſe: but in ſome they are larger at one end, and in others at the middle, than in any other part of the body; and ſome ſpecies have one of the rays bifid, ſo as to emulate the appearance of a ſix-rayed kind.

Star-Thiſtle, in botany. See Centaurea.

Star-Wort, in botany. See Aster.

STARCH, a fecula or ſediment, found at the bottom of veſſels wherein wheat has been ſteeped in water, of which fecula, after ſeparating the bran from it, by paſſing it through ſieves, they form a kind of loaves, which being dried in the ſun or an oven, is afterwards cut into little pieces, and ſo ſold. The beſt ſtarch is white, ſoft, and friable, and eaſily broken into powder. Such as require fine ſtarch, do not content themſelves, like the ſtarchmen, with refuſe wheat, but uſe the fineſt grain. The proceſs is as follows: The grain, being well cleaned, is put to ferment in veſſels full of water, which they expoſe to the ſun while in its greateſt heat; changing the water twice a-day, for the ſpace of eight or twelve days, according to the ſeaſon. When the grain burſts eaſily under the finger, they judge it ſufficiently fermented. The fermentation perfected, and the grain thus ſoftened, it is put, handful by handful, into a canvas-bag, to ſeparate the flour from the huſks; which is done by rubbing and beating it on a plank laid acroſs the mouth of an empty veſſel that is to receive the flour.

As the veſſels are filled with this liquid flour, there is ſeen ſwimming at top a reddiſh water, which is to be carefully ſcummed off from time to time, and clean water is to be put in its place, which, after ſtirring the whole together, is alſo to be ſtrained through a cloth or ſieve, and what is left behind put into the veſſel with new water, and expoſed to the ſun for ſome time. As the ſediment thickens at the bottom, they drain off the water four or five times, by inclining the veſſel, but without paſſing it through the ſieve. What remains at bottom is the ſtarch, which they cut in pieces to get out, and leave it to dry in the ſun. When dry, it is laid up for uſe.

Stark.

STARK (Dr William), known to the public by a volume containing *Clinical and Anatomical Obſervations*, with ſome curious *Experiments on Diet*, was born at Manchеſter in the month of July 1740; but the family from which he ſprang was Scotch, and reſpectable for its antiquity. His grandfather John Stark of Killermont was a covenanter; and having appeared in arms againſt his ſovereign at the battle of Bothwell bridge in the year 1679, became obnoxious to the government, and to conceal himſelf, withdrew into Ireland. There is reaſon to believe that he had not imbibed either the extravagant zeal or the ſavage manners of the political and religious party to which he adhered; for after reſiding a few years in the country which he had choſen for the ſcene of his baniſhment, he married Elizabeth daughter of Thomas Stewart Eſq; of Balydrene in the north of Ireland; who, being deſcended of the noble family of Galloway, would not probably have matched his daughter to ſuch an exile as a ruthleſs fanatic of the laſt century. By this lady Mr Stark had ſeveral children; and his ſecond ſon Thomas, who ſettled at Manchеſter as a wholeſale linen-draper, and married Margaret Stirling, daughter of William Stirling, Eſq; of Northwoodſide, in the neighbourhood of Glaſgow, was the father of the ſubject of this article. Another of his ſons, the reverend John Stark, was miniſter of Lecropt in Perthſhire; and it was under the care of this gentleman that our author received the rudiments of his education, which, when we conſider the character of the maſter, and reflect on the relation between him and his pupil, we may preſume was calculated to ſtore the mind of Dr Stark with thoſe virtuous principles which influenced his conduct through life.

From Lecropt young Stark was ſent to the univerſity of Glaſgow, where, under the tuition of the Doctors Smith and Black, with other eminent maſters, he learned the rudiments of ſcience, and acquired that mathematical accuracy, that logical preciſion, and that contempt of hypotheſes, with which he proſecuted all his future ſtudies. Having choſen phyſic for his profeſſion, he removed from the univerſity of Glaſgow to that of Edinburgh, where he was ſoon diſtinguiſhed, and honoured with the friendſhip of the late Dr Cullen; a man who was not more eminently conſpicuous for the ſuperiority of his own genius, than quick-ſighted in perceiving, and liberal in encouraging, genius in his pupils. Having finiſhed his ſtudies at Edinburgh, though he took there no degree, Mr Stark, in the year 1765, went to London, and devoted himſelf entirely to the ſtudy of phyſic and the elements of ſurgery; and looking upon anatomy as one of the principal pillars of both theſe arts, he endeavoured to complete with Dr Hunter what he had begun with Dr Monro; and under theſe two eminent profeſſors he appears to have acquired a high degree of anatomical knowledge. He likewiſe entered himſelf about this time a pupil at St George's hoſpital; for being diſguſted, as he often confeſſed, with the inaccuracy or want of candour obſervable in the generality of practical writers, he determined to obtain an acquaintance with diſeaſes at a better ſchool and from an abler maſter; and to have from his own experience a ſtandard, by which he might judge of the ex-

Stark. perience of others. With what induſtry he proſecuted this plan, and with what ſucceſs his labours were crowned, may be ſeen in a ſeries of *Clinical and Anatomical Obſervations*, which were made by him during his attendance at the hoſpital, and were publiſhed after his death by his friend Dr Carmichael Smyth. Theſe obſervations give the public no cauſe to complain of want of candour in their author; for whatever delicacy he may have obſerved, when relating the caſes of patients treated by other phyſicians, he has related thoſe treated by himſelf with the utmoſt impartiality. Whilſt attending the hoſpital, he likewiſe employed himſelf in making experiments on the blood, and other animal fluids; and alſo in a courſe of experiments in chemical pharmacy; but though accounts of theſe experiments were left behind him, we believe they have not yet been given to the public.

In the year 1767 Mr Stark went abroad and obtained the degree of M. D. in the univerſity of Leyden, publiſhing an inaugural diſſertation on the dyſentery. On his return to London, he recommenced his ſtudies at the hoſpital; and when Dr Black was called to the chemical chair in Edinburgh, which he has long filled with ſo much honour to himſelf and credit to the univerſity, Dr Stark was ſolicited by ſeveral members of the univerſity of Glaſgow to ſtand a candidate for their profeſſorſhip of the theory and practice of phyſic, rendered vacant by Dr Black's removal to Edinburgh. This however Dr Stark declined, being influenced by the advice of his Engliſh friends, who wiſhed to detain him in London, and having likewiſe ſome proſpects of an appointment in the hoſpital.

In the mean time he had commenced (1769) a ſeries of experiments on diet, which he was encouraged to undertake by Sir John Pringle and Dr Franklin, whoſe friendſhip he enjoyed, and from whom he received many hints reſpecting both the plan and its execution. Theſe experiments, or rather the imprudent zeal with which he proſecuted them, proved in the opinion of his friends, fatal to himſelf; for he began them on the 12th of July 1669 in perfect health and vigour, and from that day, though his health varied, it was ſeldom if ever good, till the 23d of February 1770, when he died, after ſuffering much uneaſineſs. His friend and biographer Dr Smyth thinks, that other cauſes, particularly chagrin and diſappointment, had no ſmall ſhare in haſtening his death; and as the Doctor was intimately acquainted with his character and diſpoſition, his opinion is probably well-founded, though the pernicious effects of the experiments are viſible in Dr Stark's own journal. When he entered upon them, the weight of his body was 12 ſtone 3 lb. avoirdupois, which in a very few days was reduced to 11 ſtone 10 lb 8 oz: and though ſome kinds of food increaſed it, by much the greater part of what he uſed had a contrary effect, and it continued on the whole to decreaſe till the day of his death. This indeed can excite no wonder. Though the profeſſed object of his experiments was to prove that a *pleaſant* and varied diet is equally conducive to health with a more ſtrict and ſimple one, moſt of the diſhes which he ate during theſe experiments were neither pleaſant nor ſimple, but compounds, ſuch as every ſtomach muſt nauſeate. He began with *bread* and *water*; from which he proceeded to *bread*, *water*, and *ſugar*; then to *bread*, *water*, and *oil of olives*; then to *bread* and *water* with *milk*; afterwards he tried *bread* and *water* with *roaſted gooſe*; *bread* and *water* with *boiled beef*; *ſtewed lean of beef* with the *gravy* and *water* without bread; *ſtewed lean of beef* with the *gravy*, *oil* of *fat* or *ſuet* and *water*; *flour*, *oil of ſuet*, *water* and *ſalt*; *flour*, *water*, and *ſalt*; and a number of others infinitely more diſagreeable to the ſtomach than even theſe, ſuch as *bread*, *fat of bacon ham*, *infuſion of tea* with *ſugar*; and *bread* or *flour* with *honey* and the infuſion of *roſemary*. But though we conſider Dr Stark's experiments as whimſical, it cannot be denied that they indicate eccentricity of genius in the perſon who made them; and ſuch of our readers as think genius hereditary, may perhaps be of opinion, that he derived a ray from the celebrated Napier the inventor of the logarithms, who was his anceſtor by both parents. At any rate, theſe experiments, of which a full account is given in the ſame volume with his clinical and anatomical obſervations, diſplay an uncommon degree of fortitude, perſeverance, ſelf-denial, and zeal for the promoting of uſeful knowledge in their author; and with reſpect to his moral character, we believe it is with great juſtice that Dr Smyth compares him to Cato by applying to him what was ſaid of that virtuous Roman by Salluſt.—"Non divitiis cum divite, neque factione cum factioſo; ſed cum ſtrenuo virtute, cum modeſto pudore, cum innocente abſtinentia certabat; eſſe, quam videri, bonus malebat *."

* *Bellum Catilinarium.*

STARLING. See Sturnus.

STATE of a Controversy. See Oratory, Part I. n° 14.

STATES, or Estates, a term applied to ſeveral orders or claſſes of people aſſembled to conſult of matters for the public good.

Thus ſtates-general is the name of an aſſembly conſiſting of the deputies of the ſeven United Provinces. Theſe are uſually 30 in number, ſome provinces ſending two, others more; and whatever reſolution the ſtates-general take, muſt be confirmed by every province, and by every city and republic in that province, before it has the force of a law. The deputies of each province, of what number ſoever they be, have only one voice, and are eſteemed as but one perſon, the votes being given by provinces. Each province preſides in the aſſembly in its turn, according to the order ſettled among them. Gvelderland preſides firſt, then Holland, &c.

States of Holland are the deputies of eighteen cities, and one repreſentative of the nobility, conſtituting the ſtates of the province of Holland: the other provinces have likewiſe their ſtates, repreſenting their ſovereignty; deputies from which make what they call the ſtates-general. In an aſſembly of the ſtates of a particular province, one diſſenting voice prevents their coming to any reſolution.

Statice Thrift, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *pentagynia*; and in the natural ſyſtem ranging under the 48th order, *aggregatæ*. The calyx is monophyllous, entire, folded, and ſcarioſe. There are five petals, with one ſuperior ſeed. There are 22 ſpecies, the armeria, pſeudarmeria, limonium, incana, cordata, reticulata, echioides, ſpecioſa, tatarica, echinus, flexuoſa, purpurata, minuta, ſuffruticoſa, monopetala, aurea, ferulacea, limifolia, pruinoſa, ſinuata, mucronata, and lobata. Three of theſe are Britiſh plants.

1. The *armeria*, thrift, or ſea gilly-flower, has a ſimple naked

Stark || Statice.

Statics. naked ſtem about ſix inches high. The radical leaves are like graſs. The flowers are terminal, pale red, with a round head, and not very large. This plant flowers in July or Auguſt, and grows in meadows near the ſea.

2. *Limonium*, ſea-lavender. The ſtem is naked, branched, and about a foot high. The radical leaves are long, pointed, and grow on footſtalks. The flowers are blue, and grow on long ſpikes on the tops of the branches. It grows on the ſea-coaſt in South Britain.

3. *Reticulata*, matted ſea-lavender. The ſtem is proſtrate, and terminated by a panicle of flowers. The branches are naked, barren, and bent back. The leaves are wedge-ſhaped. This ſpecies is alſo found on the ſea-coaſt of South Britain.

STATICS, a term which the modern improvements in knowledge have made it neceſſary to introduce into phyſico-mathematical ſcience. It was found convenient to diſtribute the doctrines of univerſal mechanics into two claſſes, which required both a different mode of conſideration and different principles of reaſoning.

Till the time of Archimedes little ſcience of this kind was poſſeſſed by the ancients, from whom we have received the firſt rudiments. His inveſtigation of the centre of gravity, and his theory of the lever, are the foundations of our knowledge of common mechanics; and his theory of the equilibrium of floating bodies contains the greateſt part of our hydroſtatical knowledge. But it was as yet limited to the ſimpleſt caſes; and there were ſome in which Archimedes was ignorant, or was miſtaken. The marquis Guido Ubuldi, in 1578, publiſhed his theory of mechanics, in which the doctrines of Archimedes were well explained and conſiderably augmented. Stevinus, the celebrated Dutch engineer, publiſhed about 20 years after an excellent ſyſtem of mechanics, coutaining the chief principles which now form the ſcience of equilibrium among ſolid bodies. In particular, he gave the theory of inclined planes, which was unknown to the ancients, though it is of the very firſt importance in almoſt every machine. He even ſtates in the moſt expreſs terms the principle afterwards made the foundation of the whole of mechanics, and publiſhed as a valuable diſcovery by Varignon, viz. that three forces, whoſe directions and intenſities are as the ſides of a triangle, balance each other. His theory of the preſſure of fluids, or hydroſtatics, is no leſs eſtimable, including every thing that is now received as a leading principle in the ſcience. When we conſider the ignorance, even of the moſt learned, of that age in mechanical or phyſico-mathematical knowledge, we muſt conſider thoſe performances as the works of a great genius, and we regret that they are ſo little known, being loſt in a croud of good writings on thoſe ſubjects which appeared ſoon after.

Hitherto the attention had been turned entirely to equilibrium, and the circumſtances neceſſary for producing it. Mechanicians indeed ſaw, that the energy of a machine might be ſomehow meaſured by the force which could be oppoſed or overcome by its intervention: but they did not remark, that the force which prevented its motion, but did no more than prevent it, was an *exact* meaſure of its energy, becauſe it was in immediate equilibrio with the preſſure exerted by that part of the machine with which it was connected. If this oppoſed force was leſs, or the force acting at the other extremity of the machine was greater, the mechanicians knew that the machine would move, and that work would be performed; but what would be the rate of its motion or its performance, they hardly pretended to conjecture. They had not ſtudied the action of moving forces, nor conceived what was done when motion was communicated. Statics.

The great Galileo opened a new field of ſpeculation in his work on Local Motion. He there conſiders a change of motion as the indication and exact and adequate meaſure of a moving force; and he conſiders every kind of preſſure as competent to the production of ſuch changes.—He contented himſelf with the application of this principle to the motion of bodies by the action of gravity, and gave the theory of projectiles, which remains to this day without change, and only improved by conſidering the changes which are produced in it by the reſiſtance of the air.

Sir Iſaac Newton took up this ſubject nearly as Galileo had left it. For, if we except the theory of the centrifugal forces ariſing from rotation, and the theory of pendulums, publiſhed by Huygens, hardly any thing had been added to the ſcience of motion. Newton conſidered the ſubject in its utmoſt extent; and in his mathematical principles of natural philoſophy he conſiders every conceivable variation of moving force, and determines the motion reſulting from its action.—His firſt application of theſe doctrines was to explain the celeſtial motions; and the magnificence of this ſubject cauſed it to occupy for a while the whole attention of the mathematicians. But the ſame work contained propoſitions equally conducive to the improvement of common mechanics, and to the complete underſtanding of the mechanical actions of bodies. Philoſophers began to make theſe applications alſo. They ſaw that every kind of work which is to be performed by a machine may be conſidered abſtractedly as a retarding force; that the impulſe of water or wind, which are employed as moving powers, act by means of preſſures which they exert on the impelled point of the machine; and that the machine itſelf may be conſidered as an aſſemblage of bodies moveable in certain limited circumſtances, with determined directions and proportions of velocity. From all theſe conſiderations reſulted a general abſtract condition of a body acted on by known powers. And they found, that after all conditions of equilibrium were ſatisfied, there remains a ſurplus of moving force. They could now ſtate the motion which will enſue, the new reſiſtance which this will excite, the additional power which this will abſorb; and they at laſt determined a new kind of equilibrium, not thought of by the ancient mechanicians, between the reſiſtance to the machine performing work and the moving power, which exactly balance each other, and is indicated, not by the *reſt*, but by the *uniform motion* of the machine.—In like manner, the mathematician was enabled to calculate that preciſe motion of water which would completely abſorb, or, in the new language, balance the ſuperiority of preſſure by which water is forced through a ſluice, a pipe, or canal, with a conſtant velocity.

Thus the general doctrines of motion came to be conſidered in two points of view, according as they balanced each other in a ſtate of reſt or of uniform motion. Theſe two ways of conſidering the ſame ſubject required both different principles and a different manner of reaſoning. The firſt has been named Statics, as expreſſing

Statics. preſſing that reſt which is the teſt of this kind of equilibrium. The ſecond has been called DYNAMICS or UNIVERSAL MECHANICS, becauſe the different kinds of motion are characteriſtic of the powers or forces which produce them. A knowledge of both is indiſpenſably neceſſary for acquiring any uſeful practical knowledge of machines: and it was ignorance of the doctrines of accelerated and retarded motions which made the progreſs of practical mechanical knowledge ſo very ſlow and imperfect. The mechanics, even of the moderns, before Galileo, went no further than to ſtate the proportion of the power and reſiſtance which would be balanced by the intervention of a given machine, or the proportion of the parts of a machine by which two known forces may balance each other. This view of the matter introduced a principle, which even Galileo conſidered as a mechanical axiom, viz. that *what is gained in force by means of a machine is exactly compenſated by the additional time which it obliges us to employ*. This is falſe in every inſtance, and not only prevents improvement in the conſtruction of machines, but leads us into erroneous maxims of conſtruction. The true principles of dynamics teach us, that there is a certain proportion of the machine, dependent on the kind and proportion of the power and reſiſtance, which enables the machine to perform the greateſt poſſible work.

It is highly proper therefore to keep ſeparate theſe two ways of conſidering machines, that both may be improved to the utmoſt, and then to blend them together in every practical diſcuſſion.

Statics therefore is preparatory to the proper ſtudy of mechanics; but it does not hence derive all its importance. It is the ſole foundation of many uſeful parts of knowledge. This will be beſt ſeen by a brief enumeration.

1. It comprehends all the doctrines of the excitement and propagation of preſſure through the parts of ſolid bodies, by which the energies of machines are produced. A preſſure is exerted on the impelled point of a machine, ſuch as the float-boards or buckets of a mill-wheel. This *excites* a preſſure at the pivots of its axle, which act on the points of ſupport. This muſt be underſtood, both as to direction and intenſity, that it may be effectually reſiſted. A preſſure is alſo excited at the acting tooth of the cog-wheel on the ſame axle, by which it urges round another wheel, exciting ſimilar preſſures on its pivots and on the acting tooth perhaps of a third wheel.—Thus a preſſure is ultimately excited in the working point of the machine, perhaps a wiper, which lifts a heavy ſtamper, to let it fall again on ſome matter to be pounded. Now ſtatics teaches us the intenſities and direction of all thoſe preſſures, and therefore how much remains at the working point of the machine unbalanced by reſiſtance.

2. It comprehends every circumſtance which influences the ſtability of heavy bodies; the inveſtigation and properties of the centre of gravity; the theory of the conſtruction of arches, vaults, and domes; the attitudes of animals.

3. The ſtrength of materials, and the principles of conſtruction, ſo as to make the proper adjuſtment of ſtrength and ſtrain in every part of a machine, edifice, or ſtructure of any kind. Statics therefore furniſhes us with what may be called *a theory of carpentry*, and gives us proper inſtructions for framing floors, roofs, centres, &c. Statics, Statiſtics.

4. Statics comprehends the whole doctrine of the preſſure of fluids, whether liquid or aeriform, whether ariſing from their weight or from any external action. Hence therefore we derive our knowledge of the ſtability of ſhips, or their power of maintaining themſelves in a poſition nearly upright, in oppoſition to the action of the wind on their ſails. We learn on what circumſtances of figure and ſtowage this quality depends, and what will augment or diminiſh it.

Very complete examples will be given in the remaining part of this work of the advantages of this ſeparate conſideration of the condition of a machine at reſt and in working motion; and in what yet remains to be delivered of the hydraulic doctrines in our account of *WATER-Works* in general, will be perceived the propriety of ſtating apart the equilibrium which is indicated by the uniform motion of the fluid. The obſervations too which we have to make on the ſtrength of the materials employed in our edifices or mechanical ſtructures, will be examples of the inveſtigation of thoſe powers, preſſures, or ſtrains, which are excited in all their parts.

STATISTICS, a word lately introduced to expreſs a view or ſurvey of any kingdom, county, or pariſh.

A Statiſtical view of Germany was publiſhed in 1790 by Mr B. Clarke; giving an account of the imperial and territorial conſtitutions, forms of government, legiſlation, adminiſtration of juſtice, and of the eccleſiaſtical ſtate; with a ſketch of the character and genius of the Germans; a ſhort inquiry into the ſtate of their trade and commerce; and giving a diſtinct view of the dominions, extent, number of inhabitants to a ſquare mile; chief towns, with their ſize and population; revenues, expences, debts, and military ſtrength of each ſtate. In Pruſſia, in Saxony, Sardinia, and Tuſcany, attempts have alſo been made to draw up ſtatiſtical accounts; but they were done rather with a view of aſcertaining the preſent ſtate of theſe countries, than as the means of future improvement.

A grand and extenſive work of this kind, founded on a judicious plan, conducted by the moſt patriotic and enlightened motives, and drawn up from the communications of the whole body of the clergy, was undertaken in Scotland in the year 1790 by Sir John Sinclair of Ulbſter, one of the moſt uſeful members of his country. Many praiſes are heaped upon genius and learning; but to genius and learning no applauſe is due, except when exerted for the benefit of mankind: but gratitude and praiſe is due to him whoſe talents ſhine only in great undertakings, whoſe happineſs ſeems to conſiſt in patriotic exertions, and whoſe judgment is uniformly approved by his ſucceſs. A work of this kind, ſo important in its object, ſo comprehenſive in its range, ſo judicious in its plan, and drawn up by more than 900 men of literary education, many of them men of great genius and learning, muſt be of immenſe value. Sixteen volumes octavo are already publiſhed; and it is ſuppoſed that the work will be completed in two or three additional volumes.

The great object of this work is to give an accurate view of the ſtate of the country, its agriculture, its manufactures, and its commerce; the means of improvement, of which they are reſpectively capable; the amount of the population of a ſtate, and the cauſes of its increaſe

Statiſtics. or decreaſe; the manner in which the territory of a country is poſſeſſed and cultivated; the nature and amount of the various productions of the ſoil; the value of the perſonal wealth or ſtock of the inhabitants, and how it can be augmented; the diſeaſes to which the people are ſubject, their cauſes and their cure; the occupations of the people; where they are entitled to encouragement, and where they ought to be ſuppreſſed; the condition of the poor, the beſt mode of maintaining them, and of giving them employment; the ſtate of ſchools, and other inſtitutions, formed for purpoſes of public utility; the ſtate of the villages and towns, and the regulations beſt calculated for their police and good government; the ſtate of the manners, the morals, and the religious principles of the people, and the means by which their temporal and eternal intereſts can beſt be promoted.

To ſuch of our readers as have not an opportunity of peruſing this national work, or of examining its plan, we will preſent the ſcheme for the ſtatiſtical account of a parochial diſtrict which Sir John Sinclair publiſhed for the conſideration of the clergy, and which has been generally followed by them, though often with great improvements.

The name of the pariſh and its origin; ſituation and extent of the pariſh; number of acres; deſcription of the ſoil and ſurface; nature and extent of the ſea-coaſt; lakes, rivers, iſlands, hills, rocks, caves, woods, orchards, &c.; climate and diſeaſes; inſtances of longevity; ſtate of property; number of proprietors; number of reſiding proprietors; mode of cultivation; implements of huſbandry; manures; ſeedtime and harveſt; remarkable inſtances of good and bad ſeaſons; quantity and value of each ſpecies of crop; total value of the whole produce of the diſtrict; total real and valued rent; price of grain and proviſions; total quantity of grain and other articles conſumed in the pariſh; wages and price of labour; ſervices, whether exacted or aboliſhed; commerce; manufactures; manufacture of kelp, its amount, and the number of people employed in it; fiſheries; towns and villages; police; inns and alehouſes; roads and bridges; harbours; ferries, and their ſtate; number of ſhips and veſſels; number of ſeamen; ſtate of the church; ſtipend, manſe, glebe, and patron; number of poor; parochial funds, and the management of them; ſtate of the ſchools, and number of ſcholars; ancient ſtate of population; cauſes of its increaſe or decreaſe; number of families; exact amount of the number of ſouls now living; diviſion of the inhabitants; 1. by the place of their birth; 2. by their ages; 3. by their religious perſuaſions; 4. by their occupations and ſituation in life; 5. by their reſidence, whether in town, village, or in the country; number of houſes; number of uninhabited houſes; number of dove-cots, and to what extent they are deſtructive to the crops; number of horſes, their nature and value; number of cattle, their nature and value; number of ſheep, their nature and value; number of ſwine, their nature and value; minerals in general; mineral ſprings; coal and fuel; eminent men; antiquities; parochial records; miſcellaneous obſervations; character of the people; their manners, cuſtoms, ſtature, &c.; advantages and diſadvantages; means by which their ſituation could be meliorated.

If ſimilar ſurveys (ſays the public-ſpirited editor of this work) were inſtituted in the other kingdoms of Europe, it might be the means of eſtabliſhing, on ſure foundations, the principles of that moſt important of all ſciences, viz. political or ſtatiſtical philoſophy; that is, the ſcience, which, in preference to every other, ought to be held in reverence. No ſcience can furniſh, to any mind capable of receiving uſeful information, ſo much real entertainment; none can yield ſuch important hints, for the improvement of agriculture, for the extenſion of commercial induſtry, for regulating the conduct of individuals, or for extending the proſperity of the ſtate; none can tend ſo much to promote the general happineſs of the ſpecies.

Statius || Statue.

STATIUS (Publius Papinius), a celebrated Latin poet of the firſt century, was born at Naples, and was the ſon of Statius, a native of Epirus, who went to Rome to teach poetry and eloquence, and had Domitian for his ſcholar. Statius the poet alſo obtained the favour and friendſhip of that prince; and dedicated to him his Thebais and Achilleis; the firſt in twelve books, and the laſt in two. He died at Naples about the year 100. Beſides the above poems, there are alſo ſtill extant his *Sylvæ*, in five books; the ſtyle of which is purer, more agreeable, and more natural, than that of his Thebais and Achilleis.

STATUARY, a branch of ſculpture, employed in the making of ſtatues. See SCULPTURE and the next article.

Statuary is one of thoſe arts wherein the ancients ſurpaſſed the moderns; and indeed it was much more popular, and more cultivated, among the former than the latter. It is diſputed between ſtatuary and painting, which of the two is the moſt difficult and the moſt artful.

Statuary is alſo uſed for the artificer who makes ſtatues. Phidias was the greateſt ſtatuary among the ancients, and Michael Angelo among the moderns.

STATUE, is defined to be a piece of ſculpture in full relievo, repreſenting a human figure. Daviler more ſcientifically defines ſtatue a repreſentation, in high relievo and inſulate, of ſome perſon diſtinguiſhed by his birth, merit, or great actions, placed as an ornament in a fine building, or expoſed in a public place, to preſerve the memory of his worth. In Greece one of the higheſt honours to which a citizen could aſpire was to obtain a ſtatue.

Statues are formed with the chiſel, of ſeveral matters, as ſtone, marble, plaſter, &c. They are alſo caſt of various kinds of metal, particularly gold, ſilver, braſs, and lead. For the method of caſting ſtatues, ſee the article *FOUNDERY of Statues*.

Statues are uſually diſtinguiſhed into four general kinds. The firſt are thoſe leſs than the life; of which kind we have ſeveral ſtatues of great men, of kings, and of gods themſelves. The ſecond are thoſe equal to the life; in which manner it was that the ancients, at the public expence, uſed to make ſtatues of perſons eminent for virtue, learning, or the ſervices they had done. The third are thoſe that exceed the life; among which thoſe that ſurpaſſed the life once and a half were for kings and emperors; and thoſe double the life, for heroes. The fourth kind were thoſe that exceeded the life twice, thrice, and even more, and were called *coloſſuſes*. See COLOSSUS.

Every ſtatue reſembling the perſon whom it is intended to repreſent, is called *ſtatua iconica*. Statues acquire various other denominations. 1. Thus, allegorical ſtatue is that which, under a human figure, or other ſymbol, repre-

Statue || Stay.

represents something of another kind; as a part of the earth, a season, age, element, temperament, hour, &c. 2. Curule statues, are those which are represented in chariots drawn by bigæ or quadrigæ, that is, by two or four horses; of which kind there were several in the circuses, hippodromes, &c. or in cars, as we see some, with triumphal arches on antique medals. 3. Equestrian statue, that which represents some illustrious person on horseback, as that famous one of Marcus Aurelius at Rome; that of king Charles I. at Charing-cross; King George II in Leicester-Square, &c. 4. Greek statue, denotes a figure that is naked and antique; it being in this manner the Greeks represented their deities, athletæ of the olympic games, and heroes; the statues of heroes were particularly called *Achillean statues*, by reason of the great number of figures of Achilles in most of the cities of Greece. 5. Hydraulic statue, is any figure placed as an ornament of a fountain or grotto, or that does the office of a *jet d'eau*, a cock, spout, or the like, by any of its parts, or by any attribute it holds: the like is to be understood of any animal serving for the same use. 6. Pedestrian statue, a statue standing on foot; as that of king Charles II. in the Royal Exchange, and of king James II. in the Privy-Gardens. 7. Roman statue, is an appellation given to such as are clothed, and which receive various names from their various dresses. Those of emperors, with long gowns over their armour, were called *statuæ paludatæ:* those of captains and cavaliers, with coats of arms, *thoracatæ;* those of soldiers with cuirasses, *loricatæ;* those of senators and augurs, *trabeatæ;* those of magistrates with long robes, *togatæ;* those of the people with a plain tunica, *tunicatæ;* and, lastly, those of women with long trains, *stolatæ*.

In repairing a statue cast in a mould, they touch it up with a chisel, graver, or other instrument, to finish the places which have not come well off: they also clear off the barb, and what is redundant in the joints and projectures.

STATURE. See DWARF and GIANT.

STATUTE, in its general sense, signifies a law, ordinance, decree, &c. See LAW, &c.

STATUTE, in our laws and customs, more immediately signifies an act of parliament made by the three estates of the realm; and such statutes are either general, of which the courts at Westminster must take notice without pleading them; or they are special and private, which last must be pleaded.

STAVESACRE, in botany; a species of DELPHINIUM.

STAY, a large strong rope employed to support the mast on the fore-part, by extending from its upper end towards the fore-part of the ship, as the shrouds are extended to the right and left, and behind it. See MAST, RIGGING, and SHROUD.

The stay of the fore-mast *a*, fig. 3. plate CCLXXVI. which is called the *fore-stay*, reaches from the mast-head towards the bowsprit-end: the main-stay *b* extends over the forecastle to the ship's stem; and the mizen-stay *c* is stretched down to that part of the main-mast which lies immediately above the quarter-deck: the fore-top-mast stay *d* comes also to the end of the bowspirit, a little beyond the fore-stay: the main-top-mast stay *e* is attached to the head or hounds of the fore-mast; and the mizen-top-mast stay comes also to the hounds of the main-mast: the fore-top-gallant stay comes to the outer end of the jib-boom; and the main-top gallant stay is extended to the head of the fore-top-mast.

Stay, Steam.

Star-Sail, a sort of triangular sail extended upon a stay. See SAIL.

STEAM, is the name given in our language to the visible moist vapour which arises from all bodies which contain juices easily expelled from them by heats not sufficient for their combustion. Thus we say, the steam of boiling water, of malt, of a tan-bed, &c. It is distinguished from smoke by its not having been produced by combustion, by not containing any soot, and by its being condensible by cold into water, oil, inflammable spirits, or liquids composed of these. 1 Definition.

We see it rise in great abundance from bodies when they are heated, forming a white cloud, which diffuses itself and disappears at no very great distance from the body from which it was produced. In this case the surrounding air is found loaded with the water or other juices which seem to have produced it, and the steam seems to be completely soluble in air, as salt is in water, composing while thus united a transparent elastic fluid. 2 Appears like a white cloud

But in order to its appearance in the form of an opaque white cloud, the mixture with or dissemination in air seem absolutely necessary. If a tea-kettle boils violently, so that the steam is formed at the spout in great abundance, it may be observed, that the visible cloud is not formed at the very mouth of the spout, but at a small distance before it, and that the vapour is perfectly transparent at its first emission. This is rendered still more evident by fitting to the spout of the tea-kettle a glass pipe of any length, and of as large a diameter as we please. The steam is produced as copiously as without this pipe, but the vapour is transparent through the whole length of the pipe. Nay, if this pipe communicate with a glass vessel terminating in another pipe, and if the vessel be kept sufficiently hot, the steam will be as abundantly produced at the mouth of this second pipe as before, and the vessel will be quite transparent. The visibility therefore of the matter which constitutes the steam is an accidental or extraneous circumstance, and requires the admixture with air; yet this quality again leaves it when united with air by solution. It appears therefore to require a *dissemination* in the air. The appearances are quite agreeable to this notion: for we know that one perfectly transparent body, when minutely divided and diffused among the parts of another transparent body, but not dissolved in it, makes a mass which is visible. Thus oil beat up with water makes a white opaque mass. 3 When disseminated in air.

In the mean time, as steam is produced, the water gradually wastes in the tea kettle, and will soon be totally expended, if we continue it on the fire. It is reasonable therefore to suppose, that this steam is nothing but water changed by heat into an aërial or elastic form. If so, we should expect that the privation of this heat would leave it in the form of water again. Accordingly this is fully verified by experiment; for if the pipe fitted to the spout of the tea-kettle be surrounded with cold water, no steam will issue, but water will continually trickle from it in drops; and if the process be conducted with the proper precautions, the water which we thus obtain from the pipe will be found equal 4 Is again converted into water by cold.

Steam. equal in quantity to that which diſappears from the tea-kettle.

5 Its appearances explained, This is evidently the common proceſs for diſtilling; and the whole appearances may be explained by ſaying, that the water is converted by heat into an elaſtic vapour, and that this, meeting with colder air, imparts to it the heat which it carried off as it aroſe from the heated water, and being deprived of its heat it is again water. The particles of this water being vaſtly more remote from each other than when they were in the tea-kettle, and thus being diſſeminated in the air, become viſible, by reflecting light from their anterior and poſterior ſurfaces, in the ſame manner as a tranſparent ſalt becomes viſible when reduced to a fine powder. This diſſeminated water being preſented to the air in a very extended ſurface, is quickly diſſolved by it, as pounded ſalt is in water, and again becomes a tranſparent fluid, but of a different nature from what it was before, being no longer convertible into water by depriving it of its heat.

Accordingly this opinion, or ſomething very like it, has been long entertained. Muſchenbroeck expreſsly ſays, that the water in the form of vapour carries off with it all the heat which is continually thrown in by the fuel. But Dr Black was the firſt who attended minutely to the whole phenomena, and enabled us to form diſtinct notions of the ſubject. He had diſcovered that it was not ſufficient for converting ice into water that it be raiſed to that temperature in which it can no longer remain in the form of ice. A piece of ice of the temperature 32° of Fahrenheit's thermometer will remain a very long while in air of the temperature 50° before it be all melted, remaining all the while of the temperature 32°, and therefore continually abſorbing heat from the ſurrounding air. By comparing the time in which the ice had its temperature changed from 28° to 32° with the ſubſequent time of its complete liquefaction, he found that it abſorbed about 130 or 140 times as much heat as would raiſe its temperature one degree; and he found that one pound of ice, when mixed with one pound of water 140 degrees warmer, was juſt melted, but without riſing in its temperature above 32°. Hence he juſtly concluded, that water differed from ice of the ſame temperature by containing, as a conſtituent ingredient, a great quantity of fire, or of the cauſe of heat, united with it in ſuch a way as not to quit it for another colder body, and therefore ſo as not to go into the liquor of the thermometer and expand it. Conſidered therefore as the poſſible cauſe of heat, it was latent, which Dr Black expreſſed by the abbreviated term LATENT HEAT. If any more heat was added to the water it was not latent, but would readily quit it for the thermometer, and, by expanding the thermometer, would ſhow what is the degree of this *redundant* heat, while fluidity alone is the indication of the *combined* and latent heat.

6 And the cauſe of its converſion, by Dr Black's diſcovery of latent heat.

Dr Black, in like manner, concluded, that in order to convert water into an elaſtic vapour, it was neceſſary, not only to increaſe its uncombined heat till its temperature is 212°, in which ſtate it is juſt ready to become elaſtic; but alſo to pour into it a great quantity of fire, or the cauſe of heat, which combines with every particle of it, ſo as to make it repel, or to recede from, its adjoining particles, and thus to make it a particle of an elaſtic fluid. He ſuppoſed that this additional heat might be combined with it ſo as not to quit it for the thermometer; and therefore ſo as to be in a latent ſtate, having elaſtic fluidity for its ſole indication. Steam.

7 The temperature at which it is produced, and the quantity of heat which it abſorbs.

This opinion was very conſiſtent with the phenomenon of boiling off a quantity of water. The application of heat to it cauſes it gradually to riſe in its temperature till it reaches the temperature 212°. It then begins to ſend off elaſtic vapour, and is ſlowly expended in this way, continuing all the while of the ſame temperature. The ſteam alſo is of no higher temperature, as appears by holding a thermometer in it. We muſt conclude that this ſteam contains all the heat which is expended in its formation. Accordingly the ſcalding power of ſteam is well known; but it is extremely difficult to obtain preciſe meaſures of the quantity of heat abſorbed by water during its converſion into ſteam. Dr Black endeavoured to aſcertain this point, by comparing the time of raiſing its temperature a certain number of degrees with the time of boiling it off by the ſame external heat; and he found that the heat latent in ſteam, which balanced the preſſure of the atmoſphere, was not leſs than 800 degrees. He alſo directed Dr Irvine of Glaſgow to the form of an experiment for meaſuring the heat actually extricated from ſuch ſteam during its condenſation in the refrigeratory of a ſtill, which was found to be not leſs than 774 degrees. Dr Black was afterwards informed by Mr Watt, that a courſe of experiments, which he had made in each of theſe ways with great preciſion, determined the latent heat of ſteam under the ordinary preſſure of the atmoſphere to be about 948 or 950 degrees. Mr Watt alſo found that water would diſtil with great eaſe *in vacuo* when of the temperature 70°; and that in this caſe the latent heat of the ſteam is not leſs than 1200 or 1300 degrees: and a train of experiments, which he had made by diſtilling in different temperatures, made him conclude that the ſum of the ſenſible and latent heats is a conſtant quantity. This is a curious and not an improbable circumſtance; but we have no information of the particulars of theſe experiments. The concluſion evidently preſuppoſes a knowledge of that particular temperature in which the water has no heat; but this is a point which is ſtill *ſub judice*.

8 Steam, by being combined with heat, becomes elaſtic and light,

This converſion of liquids (for it is not confined to water, but obtains alſo in ardent ſpirits, oils, mercury, &c.) is the cauſe of their boiling. The heat is applied to the bottom and ſides of the veſſel, and gradually accumulates in the fluid, in a ſenſible ſtate, uncombined, and ready to quit it and to enter into any body that is colder, and to diffuſe itſelf between them. Thus it enters into the fluid of a thermometer, expands it, and thus gives us the indication of the degree in which it has been accumulated in the water; for the thermometer ſwells as long as it continues to abſorb ſenſible heat from the water: and when the ſenſible heat in both is in equilibrio, in a proportion depending on the nature of the two fluids, the thermometer riſes no more, becauſe it abſorbs no more heat or fire from the water; for the particles of water which are in immediate contact with the bottom, are now (by this gradual expanſion of liquidity) at ſuch diſtance from each other, that their laws of attraction for each other and for heat are totally changed. Each particle either no longer attracts, or perhaps it repels its adjoining particle, and now accumulates round itſelf a great number of the particles of

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9 And produces the phenomenon of boiling.

10 The noiſe obſerved in the boiling of a tea-kettle explained.

It is owing to a ſimilar cauſe that violent thumps are ſometimes felt on the bottom of a tea-kettle, eſpecially one which has been long in uſe. Such are frequently cruſted on the bottom with a ſtony concretion. This ſometimes is detached in little ſcales. When one of theſe is adhering by one end to the bottom, the water gets between them in a thin film. Here it may be heated conſiderably above the boiling temperature, and it ſuddenly riſes up in a large bubble, which collapſes immediately. A ſmooth ſhilling lying on the bottom will produce this appearance very violently, or a thimble with the mouth down.

11 Water will not boil unleſs the fire be applied to the bottom or ſides of the veſſel.

In order to make water boil, the fire muſt be applied to the bottom or ſides of the veſſel. If the heat be applied at the top of the water, it will waſte away without boiling; for the very ſuperficial particles are firſt ſupplied with the heat neceſſary for rendering them elaſtic, and they fly off without agitating the reſt (A).

12 No fluid can boil till the elaſticity of the vapour overcome the preſſure of the incumbent bodies.

Since this diſengagement of vapour is the effect of its elaſticity, and ſince this elaſticity is a determined force when the temperature is given, it follows, that fluids cannot boil till the elaſticity of the vapour overcomes the preſſure of the incumbent fluid and of the atmoſphere. Therefore, when this preſſure is removed or diminiſhed, the fluids muſt ſooner overcome what remains, and boil at a lower temperature. Accordingly it is obſerved that water will boil in an exhauſted receiver when of the heat of the human body. If two glaſs balls A and B (fig. 1.) be connected by a ſlender tube, and one of them A be filled with water (a ſmall opening or pipe *b* being left at top of the other), and this be made to boil, the vapour produced from it will drive all the air out of the other, and will at laſt come out itſelf, producing ſteam at the mouth of the pipe. When the ball B is obſerved to be occupied by tranſparent vapour, we may conclude that the air is completely expelled. Now ſhut the pipe by ſticking it into a piece of tallow or bees-wax; the vapour in B will ſoon condenſe, and there will be a vacuum. The flame of a lamp and blow-pipe being directed to the little pipe, will cauſe it immediately to cloſe and ſeal hermetically. We now have a pretty inſtrument or toy called a PULSE-GLASS. Graſp the ball A in the hollow of the hand; the heat of the hand will immediately expand the bub- Plate CCCCLXXVIII.

ble-

(A) We explained the opaque and cloudy appearance of ſteam, by ſaying that the vapour is condenſed by coming into contact with the cooler air. There is ſomething in the form of this cloud which is very inexplicable. The particles of it are ſometimes very diſtinguiſhable by the eye; but they have not the ſmart ſtar like brilliancy of very ſmall drops of water, but give the fainter reflection of a very thin film or veſicle like a ſoap bubble. If we attend alſo to their motion, we ſee them deſcending very ſlowly in compariſon with the deſcent of a ſolid drop; and this veſicular conſtitution is eſtabliſhed beyond a doubt by looking at a candle through a cloud of ſteam. It is ſeen ſurrounded by a faint halo with priſmatical colours, preciſely ſuch as we can demonſtrate by optical laws to belong to a collection of veſicles, but totally different from the halo which would be produced by a collection of ſolid drops. It is very difficult to conceive how theſe veſicles can be formed of watery particles, each of which was ſurrounded with many particles of fire, now communicated to the air, and how each of theſe veſicles ſhall include within it a ball of air; but we cannot refuſe the fact. We know, that if, while linſeed-oil is boiling or nearly boiling, the ſurface be obliquely ſtruck with the ladle, it will be daſhed into a prodigious number of exceedingly ſmall veſicles, which will float about in the air for a long while. Mr Sauſſure was (we think) the firſt who diſtinctly obſerved this veſicular form of miſts and clouds; and he makes conſiderable uſe of it in explaining ſeveral phenomena of the atmoſphere.

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ble of vapour which may be in it, and this vapour will drive the water into B, and then will blow up through it for a long while, keeping it in a ſtate of violent ebullition, as long as there remains a drop or film of water in A. But care muſt be taken that B is all the while kept cold, that it may condenſe the vapour as faſt as it riſes through the water. Touching B with the hand, or breathing warm on it, will immediately ſtop the ebullition in it. When the water in A has thus been diſſipated, graſp B in the hand; the water will be driven into A, and the ebullition will take place there as it did in B. Putting one of the balls into the mouth will make the ebullition more violent in the other, and the one in the mouth will feel very cold. This is a pretty illuſtration of the rapid abſorption of the heat by the particles of water which are thus converted into elaſtic vapour. We have ſeen this little toy ſuſpended by the middle of the tube like a balance, and thus placed in the inſide of a window, having two holes *a* and *b* cut in the pane, in ſuch a ſituation that when A is full of water and preponderates, B is oppoſite to the hole *b*. Whenever the room became ſufficiently warm, the vapour was formed in A, and immediately drove the water into B, which was kept cool by the air coming into the room through the hole *b*. By this means B was made to proponderate in its turn, and A was then oppoſite to the hole *a*, and the proceſs was now repeated in the oppoſite direction; and this amuſement continued as long as the room was warm enough.

13 Liquors differ much in the temperature neceſſary for their ebullition.

We know that liquors differ exceedingly in the temperatures neceſſary for their ebullition. This forms the great chemical diſtinction between volatile and fixed bodies. But the difference of temperature in which they boil, or are converted into permanently elaſtic vapour, under the preſſure of the atmoſphere, is not a certain meaſure of their differences of volatility. The natural boiling point of a body is that in which it will be converted into elaſtic vapour under no preſſure, or *in vacuo*. The boiling point in the open air depends on the law of the elaſticity of the vapour in relation to its heat. A fluid A may be leſs volatile, that is, may require more heat to make it boil *in vacuo*, than a fluid B: But if the elaſticity of the vapour of A be more increaſed by an increaſe of temperature than that of the vapour of B, A may boil at as low, or even at a lower temperature, in the open air, than B does; for the increaſed elaſticity of the vapour of A may ſooner overcome the preſſure of the atmoſphere. Few experiments have been made on the relation between the temperature and the elaſticity of different vapours. So long ago as the year 1765, we had occaſion to examine the boiling points of all ſuch liquors as we could manage in an air-pump; that is, ſuch as did not produce vapours which deſtroyed the valves and the leathers of the piſtons: and we thought that the experiments gave us reaſon to conclude, that the elaſticity of all the vapours was affected by heat nearly in the ſame degree. For we found that the difference between their boiling points in the air and *in vacuo* was nearly the ſame in all, namely, about 120 degrees of Fahrenheit's thermometer. It is exceedingly difficult to make experiments of this kind: The vapours are ſo condenſible, and change their elaſticity ſo prodigiouſly by a trifling change of temperature, that it is almoſt impoſſible to examine this point with preciſion. It is, however, as we ſhall ſee by and by, a ſubject of conſiderable practical importance in the mechanic arts; and an accurate knowledge of the relation would be of great uſe alſo to the diſtiller: and it would be no leſs important to diſcover the relation of their elaſticity and denſity, by examining their compreſſibility, in the ſame manner as we have aſcertained the relation in the caſe of what we call *aerial fluids*, that is, ſuch as we have never obſerved in the form of fluids or ſolids, except in conſequence of their union with each other or with other bodies. In the article PNEUMATICS we took notice of it as ſomething like a natural law, that all theſe airs, or gaſes as they are now called, had their elaſticity very nearly, if not exactly proportional to their denſity. This appears from the experiments of Achard, of Fontana, and others, on vital air, inflammable air, fixed air, and ſome others. It gives us ſome preſumption to ſuppoſe that it holds in all elaſtic vapours whatever, and that it is connected with their elaſticity; and it renders it ſomewhat probable that they are all elaſtic, only becauſe the cauſe of heat (the matter of fire if you will) is elaſtic, and that their law of elaſticity, in reſpect of denſity, is the ſame with that of fire. But it muſt be obſerved, that although we thus aſſign the elaſticity of fire as the immediate cauſe of the elaſticity of vapour, in the ſame way, and on the ſame grounds, that we aſcribe the fluidity of brine to the fluidity of the water which holds the ſolid ſalt in ſolution, it does not follow that this is owing, as is commonly ſuppoſed, to a repulſion or tendency to recede from each other exerted by the particles of fire. We are as much entitled to infer a repulſion of unlimited extent between the particles of water; for we ſee that by its means a ſingle particle of ſea-ſalt becomes diſſeminated through the whole of a very large veſſel. If water had not been a viſible and palpable ſubſtance, and the ſalt only had been viſible and palpable, we might have formed a ſimilar notion of chemical ſolution. But we, on the contrary, have conſidered the *quaquaverſum* motion or expanſion of the ſalt as a diſſemination among the particles of water; and we have aſcribed it to the ſtrong attraction of the atoms of ſalt for the atoms of water, and the attraction of theſe laſt for each other, thinking that each atom of ſalt accumulates round itſelf a multitude of watery atoms, and by ſo doing muſt recede from the other ſaline atoms. Nay, we farther ſee, that by forces which we naturally conſider as attractions, an expanſion may be produced of the whole maſs, which will act againſt external mechanical forces. It is thus that wood ſwells with almoſt inſuperable force by imbibing moiſture; it is thus that a ſponge immerſed in water becomes really an elaſtic compreſſible body, reſembling a blown bladder; and there are appearances which warrant us to apply this mode of conception to elaſtic fluids.—When air is ſuddenly compreſſed, a thermometer included in it ſhows a riſe of temperature; that is, an appearance of heat now redundant which was formerly combined. The heat ſeems to be ſqueezed out as the water from the ſponge.

15 To what the elaſticity of fluids may be owing.

14 Difference between their boiling points in air and *in vacuo* about 120°.

16 Aſcribed by ſome to attraction, but improperly.

Accordingly this opinion, that the elaſticity of ſteam and other vapours is owing merely to the attraction for fire, and the conſequent diſſemination of their particles through the whole maſs of fire, has been entertained by many naturaliſts, and it has been aſcribed entirely to attraction. We by no means pretend to decide; but we think the analogy by far too ſlight to found any

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confident opinion on it. The aim is to ſolve phenomena by attraction only, as if it were of more eaſy conception than repulſion. Conſidered merely as facts, they are quite on a par. The appearances of nature in which we obſerve actual receſſes of the parts of body from each other, are as diſtinct, and as frequent and familiar, as the appearances of actual approach. And if we attempt to go farther in our contemplation, and to conceive the way and the forces by which either the approximations or receſſes of the atoms are produced, we muſt acknowledge that we have no conception of the matter; and we can only ſay, that there is a cauſe of theſe motions, and we call it a force, as in every caſe of the production of motion. We call it attraction or repulſion juſt as we happen to contemplate an acceſs or a receſs. But the analogy here is not only ſlight, but imperfect, and fails moſt in thoſe caſes which are moſt ſimple, and where we ſhould expect it to be moſt complete. We can ſqueeze water out of a ſponge, it is true, or out of a piece of green wood; but when the white of an egg, the tremella, or ſome gums, ſwell to a hundred times their dry dimenſions by imbibing water, we cannot ſqueeze out a particle. If fluidity (for the reaſoning muſt equally apply to this as to vaporouſneſs) be owing to an accumulation of the extended matter of fire, which gradually expanded the ſolid by its very minute additions; and if the accumulation round a particle of ice, which is neceſſary for making it a particle of water, be ſo great in compariſon of what gives it the expanſion of one degree, as experiment obliges us to conclude—it ſeems an inevitable conſequence that all fluids ſhould be many times rarer than the ſolids from which they were produced. But we know that the difference is trifling in all caſes, and in ſome (water, for inſtance, and iron) the ſolid is rarer than the fluid. Many other arguments (each of them perhaps of little weight when taken alone, but which are all ſyſtematically connected) concur in rendering it much more probable that the matter of fire, in cauſing elaſticity, acts immediately by its own elaſticity, which we cannot conceive in any other way than as a mutual tendency in its particles to recede from each other; and we doubt not but that, if it could be obtained alone, we ſhould find it an elaſtic fluid like air. We even think that there are caſes in which it is obſerved in this ſtate. The elaſtic force of gunpowder is very much beyond the elaſticity of all the vapours which are produced in its deflagration, each of them being expanded as much as we can reaſonably ſuppoſe by the great heat to which they are expoſed. The writer of this article exploded ſome gunpowder mixed with a conſiderable portion of finely powdered quartz, and another parcel mixed with fine filings of copper. The elaſticity was meaſured by the penetration of the ball which was diſcharged, and was great in the degree now mentioned. The experiment was ſo conducted, that much of the quartz and copper was collected; none of the quartz had been melted, and ſome of the copper was not melted. The heat, therefore, could not be ſuch as to explain the elaſticity by expanſion of the vapours; and it became not improbable that fire was acting here as a detached chemical fluid by its own elaſticity. But to return to our ſubject.

17 More probably owing to a mutual repulſion between the particles of fire.

There is one circumſtance in which we think our own experiments ſhow a remarkable difference (at leaſt in degree) between the condenſible and incondenſible vapours. It is well known, that when air is very ſuddenly expanded, cold is produced, and heat when it is ſuddenly condenſed. When making experiments with the hopes of diſcovering the connection between the elaſticity and denſity of the vapours of boiling water, and alſo of boiling ſpirits of turpentine, we found the change of denſity accompanied by a change of temperature vaſtly greater than in the caſe of incoercible gaſes. When the vapour of boiling water was ſuddenly allowed to expand into five times its bulk, we obſerved the depreſſion of a large and ſenſible air thermometer to be at leaſt four or five times greater than in a ſimilar expanſion of common air of the ſame temperature. The chemical reader will readily ſee reaſons for expecting, on the contrary, a ſmaller alteration of temperature, both on account of the much greater rarity of the fluid, and on account of a partial condenſation of its water, and the conſequent diſengagement of combined heat.

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18 Probably a great difference between condenſible and incondenſible vapours;

This difference in the quantity of fire which is combined in vapours and gaſes is ſo conſiderable as to authorize us to ſuppoſe that there is ſome difference in the chemical conſtitution of vapours and gaſes, and that the connection between the ſpecific baſes of the vapour and the fire which it contains is not the ſame in air, for inſtance, as in the vapour of boiling water; and this difference may be the reaſon why the one is eaſily condenſible by cold, while the other has never been exhibited in a liquid or ſolid form, except by means of its chemical union with other ſubſtances. In this particular inſtance we know that there is an eſſential difference—that in vital or atmoſpheric air there is not only a prodigious quantity of fire which is not in the vapour of water, but that it alſo contains light, or the cauſe of light, in a combined ſtate. This is fully evinced by the great diſcovery of Mr Cavendiſh of the compoſition of water. Here we are taught that water (and conſequently its vapour) conſiſts of air from which the light and greateſt part of the fire have been ſeparated. And the ſubſequent diſcoveries of the celebrated Lavoiſier ſhow, that almoſt all the condenſible gaſes with which we are acquainted conſiſt either of airs which have already loſt much of their fire (and perhaps light too), or of matters in which we have no evidence of fire or light being combined in this manner.

19 And alſo ſome difference in the chemical conſtitution of vapour.

This conſideration may go far in explaining this difference in the condenſibility of theſe different ſpecies of aerial fluids, the gaſes and the vapours; and it is with this qualification only that we are diſpoſed to allow that all bodies are condenſible into liquids or ſolids by abſtracting the heat. In order that vital air may become liquid or ſolid, we hold that it is not ſufficient that a body be preſented to it which ſhall ſimply abſtract its heat. This would only abſtract its uncombined fire.—But another, and much larger portion remains chemically combined by means of light. A chemical affinity muſt be brought into action which may abſtract, not the fire from the oxygen (to ſpeak in the language of Mr Lavoiſier), but the oxygen from the fire and light. And our production is not the detached baſis of air, but detached heat and light, and the formation of an oxyd of ſome kind.

To proſecute the chemical conſideration of Steams farther than theſe general obſervations, which are applicable to all, would be almoſt to write a treatiſe of chemiſtry, and would be a repetition of many things which have been treated of in ſufficient detail in other

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articles of this work. We ſhall therefore conclude this article with ſome other obſervations, which are alſo general, with reſpect to the different kinds of coercible vapours, but which have a particular relation to the following article.

20 Steam riſes at different temperatures, according as the air is heavy or light,

Steam or vapour is an elaſtic fluid, whoſe elaſticity balances the preſſure of the atmoſphere; and it has been produced from a ſolid or liquid body raiſed to a ſufficient temperature for giving it this elaſticity; that is, for cauſing the fluid to boil. This temperature muſt vary with the preſſure of the air. Accordingly it is found, that when the air is light (indicated by the barometer being low), the fluid will boil ſooner. When the barometer ſtands at 30 inches, water boils at the temperature 212°. If it ſtand ſo low as 28 inches, water will boil at 208½. In the plains of Quito, or at Gondar in Abyſſinia, where the barometer ſtands at about 21 inches, water will boil at 195°. Highly rectified alcohol will boil at 160°, and vitriolic æther will boil at 88° or 89°. This is a temperature by no means uncommon in theſe places; nay, the air is frequently warmer. Vitriolic æther, therefore, is a liquor which can hardly be known in thoſe countries. It is hardly poſſible to preſerve it in that form. If a phial have not its ſtopper firmly tied down, it will be blown out, and the liquor will boil and be diſſipated in ſteam. On the top of Chimboracao, the human blood muſt be diſpoſed to give out air-bubbles.

21 As fluids boil under the preſſure of the vapour which aſcends from them, the concluſion mentioned in n° 14. is only a groſs approximation.

We ſaid ſome time ago, that we had concluded, from ſome experiments made in the receiver of an air-pump, that fluids boil *in vacuo* at a temperature nearly 120 degrees lower than that neceſſary for their boiling in the open air. But we now ſee that this muſt have been but a groſs approximation; for in theſe experiments the fluids were boiling under the preſſure of the vapour which they produced, and which could not be abſtracted by working the pump. It appears from the experiments of Lord Charles Cavendiſh, mentioned in the article PNEUMATICS, that water of the temperature 72° was converted into elaſtic vapour, which balanced a preſſure of ¾ths of an inch of mercury, and in this ſtate it occupied the receiver, and did not allow the mercury in the gauge to ſink to the level. As faſt as this was abſtracted by working the air-pump, more of it was produced from the ſurface of the water, ſo that the preſſure continued the ſame, and the water did not boil. Had it been poſſible to produce a vacuum above this water, it would have boiled for a moment, and would even have continued to boil, if the receiver could have been kept very cold.

22 Account of experiments to determine the relation between the temperature of vapour and its elaſticity.

Upon reading theſe experiments, and ſome very curious ones of Mr Nairne, in the Phil. Tranſ. vol. lxvii. the writer of this article was induced to examine more particularly the relation between the temperature of the vapour and its elaſticity, in the following manner:

ABCD (fig. 2.) is the ſection of a ſmall digeſter made of copper. Its lid, which is faſtened to the body with ſcrews, is pierced with three holes, each of which had a ſmall pipe ſoldered into it. The firſt hole was furniſhed with a braſs ſafety-valve V, nicely fitted to it by grinding. The area of this valve was exactly ¼th of an inch. There reſted on the ſtalk at top of this valve the arm of a ſteelyard carrying a ſliding weight. This arm had a ſcale of equal parts, ſo adjuſted to the weight that the number on the ſcale correſponded to the inches of mercury, whoſe preſſure on the under ſurface of the valve is equal to that of the ſteelyard on its top; ſo that when the weight was at the diviſion 10, the preſſure of the ſteelyard on the valve was juſt equal to that of a column of mercury 10 inches high and ¼th of an inch baſe. The middle hole contained a thermometer T firmly fixed into it, ſo that no vapour could eſcape by its ſides. The ball of this thermometer was but a little way below the lid. The third hole received occaſionally the end of a glaſs-pipe S G F, whoſe deſcending leg was about 36 inches long. When this ſyphon was not uſed, the hole was properly ſhut with a plug.

The veſſel was half filled with diſtilled water which had been purged of air by boiling. The lid was then fixed on, having the third hole S plugged up. A lamp being placed under the veſſel, the water boiled, and the ſteam iſſued copiouſly by the ſafety-valve. The thermometer ſtood at 213, and a barometer in the room at 29,9 inches. The weight was then put on the fifth diviſion. The thermometer immediately began to riſe; and when it was at 220, the ſteam iſſued by the ſides of the valve. The weight was removed to the 10th diviſion; but before the thermometer could be diſtinctly obſerved, the ſteam was iſſuing at the valve. The lamp was removed farther from the bottom of the veſſel, that the progreſs of heating might be more moderate; and when the ſteam ceaſed to iſſue from the valve, the thermometer was at 227. The weight was now ſhifted to 15; and by gradually approaching the lamp, the ſteam again iſſued, and the thermometer was at 132½. This mode of trial was continued all the way to the 75th diviſion of the ſcale. The experiments were then repeated in the contrary order; that is, the weight being ſuſpended at the 75th diviſion, and the ſteam iſſuing ſtrongly at the valve, the lamp was withdrawn, and the moment the ſteam ceaſed to come out, the thermometer was obſerved. The ſame was done at the 70th, 65th, diviſion, &c. Theſe experiments were ſeveral times repeated both ways; and the means of all the reſults for each diviſion are expreſſed in the following table, where column 1ſt expreſſes the elaſticity of the ſteam, being the ſum of 29,9, and the diviſion of the ſteelyard; column 2d expreſſes the temperature of the ſteam correſponding to this elaſticity.

I.	II
35 inches.	219°
40	226
45	232
50	237
55	242
60	247
65	251
70	255
75	259
80	263
85	267
90	270½
95	274½
100	278
105	281

A very different proceſs was neceſſary for aſcertaining the elaſticity of the ſteam in lower temperatures, and conſequently under ſmaller preſſures than that of the atmoſphere. The glaſs ſyphon SGF was now fixed into its hole in the lid of the digeſter. The water was made to boil ſmartly for ſome time, and the ſteam iſſued copiouſly both at the valve and at the ſyphon. The

lower

Steam. lower end of the ſyphon was now immerſed into a broad ſaucer of mercury, and the lamp inſtantly removed, and every thing was allowed to grow cold. By this the ſteam was gradually condenſed, and the mercury roſe in the ſyphon, without ſenſibly ſinking in the ſaucer. The valve and all the joints were ſmeared with a thick clammy cement, compoſed of oil, tallow, and roſin, which effectually prevented all ingreſs of air. The weather was clear and froſty, the barometer ſtanding at 29,84, and the thermometer in the veſſel at 42°. The mercury in the ſyphon ſtood at 29,7, or ſomewhat higher, thus ſhowing a very complete condenſation. The whole veſſel was ſurrounded with pounded ice, of the temperature 32°. This made no ſenſible change in the height of the mercury. A mark was now made at the ſurface of the mercury. One obſerver was ſtationed at the thermometer, with inſtructions to call out as the thermometer reached the diviſions 42, 47, 52, 57, and ſo on by every five degrees till it ſhould attain the boiling heat. Another obſerver noted the correſponding deſcents of the mercury by a ſcale of inches, which had its beginning placed at 29,84 from the ſurface of the mercury in the ſaucer.

The pounded ice was now removed, and the lamp placed at a conſiderable diſtance below the veſſel, ſo as to warm its contents very ſlowly. Theſe obſervations being very eaſily made, were ſeveral times repeated, and their mean reſults are ſet down in the following table: Only obſerve, that it was found difficult to note down the deſcents for every fifth degree, becauſe they ſucceeded each other ſo faſt. Every 10th was judged ſufficient for eſtabliſhing the law of variation. The firſt column of the table contains the temperature, and the ſecond the deſcent (in inches) of the mercury from the mark 29,84.

32°	☿
40	0,1
50	0,2
60	0,35
70	0,55
80	0,82
90	1,18
100	1,61
110	2,25
120	3,00
130	3,95
140	5,15
150	6,72
160	8,65
170	11,05
180	14,05
190	17,85
200	22,62
210	28,65

Four or five numbers at the top of the column of elaſticities are not ſo accurate as the others, becauſe the mercury paſſed pretty quickly through theſe points. But the progreſs was extremely regular through the remaining points; ſo that the elaſticities correſponding to temperatures above 70° may be conſidered as very accurately aſcertained.

Not being altogether ſatisfied with the method employed for meaſuring the elaſticity in temperatures above that of boiling water, a better form of experiment was adopted. (Indeed it was the want of other apparatus which made it neceſſary to employ the former). A glaſs tube was procured of the form repreſented in fig. 3. having a little ciſtern L, from the top and bottom of which proceeded the ſyphons K and MN. The ciſtern contained mercury, and the tube MN was of a ſlender bore, and was about ſix feet two inches long. The end K was firmly fixed in the third hole of the lid, and the long leg of the ſyphon was furniſhed with a ſcale of inches, and firmly faſtened to an upright poſt. Steam.

The lamp was now applied at ſuch a diſtance from the veſſel as to warm it ſlowly, and make the water boil, the ſteam eſcaping for ſome time through the ſafety valve. A heavy weight was then ſuſpended on the ſteelyard; ſuch as it was known that the veſſel would ſupport, and at the ſame time, ſuch as would not allow the ſteam to force the mercury out of the long tube. The thermometer began immediately to riſe, as alſo the mercury in the tube MN. Their correſpondent ſtations are marked in the following table:

Temp.	Elaſt^{y}.
212°	0,0
220	5,9
230	14,6
240	25,0
250	36,9
260	50,4
270	64,2
280	106,0

This form of the experiment is much more ſuſceptible of accuracy than the other, and the meaſures of elaſticity are more to be depended on. In repeating the experiment, they were found much more conſtant; whereas, in the former method, differences occurred of two inches and upwards.

We may now connect the two ſets of experiments into one table, by adding to the numbers in this laſt table the conſtant height 29,9, which was the height of the mercury in the barometer during the laſt ſet of obſervations.

Temp.	Elaſt^{y}.
32°	0,0
40	0,1
50	0,2
60	0,35
70	0,55
80	0,82
90	1,25
100	1,6
110	2,25
120	3,0
130	3,95
140	5,15
150	6,72
160	8,65
170	11,05
180	14,05
190	17,85
200	22,62
210	28,65
220	35,8
230	44,7
240	54,9
250	66,8
260	80,3
270	94,1
280	105,9

Steam.

23 Which agree well with thoſe of Mr Achard.

In the memoirs of the Royal Academy of Berlin for 1782, there is an account of ſome experiments made by Mr Achard on the elaſtic force of ſteam, from the temperature 32° to 212°. They agree extremely well with thoſe mentioned here, rarely differing more than two or three tenths of an inch. He alſo examined the elaſticity of the vapour produced from alcohol, and found, that when the elaſticity was equal to that of the vapour of water, the temperature was about 35° lower. Thus, when the elaſticity of both was meaſured by 28,1 inches of mercury, the temperature of the watery vapour was 209°, and that of the ſpirituous vapour was 173°. When the elaſticity was 18,5, the temperature of the water was 189,5, and that of the alcohol 154,6. When the elaſticity was 11,05, the water was 168°, and the alcohol 134°,4. Obſerving the difference between the temperatures of equally elaſtic vapours of water and alcohol not to be conſtant, but gradually to diminiſh, in Mr Achard's experiments, along with the elaſticity, it became intereſting to diſcover whether and at what temperature this difference would vaniſh altogether. Experiments were accordingly made by the writer of this article, ſimilar to thoſe made with water. They were not made with the ſame ſcrupulous care, nor repeated as they deſerved, but they furniſhed rather an unexpected reſult. The following table will give the reader a diſtinct notion of them:

Temp.	Elaſt.
32°	0,0
40	0,1
60	0,8
80	0,8
100	3,9
120	6,9
140	12,2
160	21,3
180	34,
200	52,4
220	78,5
240	115,

24 An unexpected reſult in comparing the temperatures of equally elaſtic vapours of water andalcohol.

We ſay that the reſult was unexpected; for as the natural boiling point ſeemed by former experiments to be in all fluids about 120° or more below their boiling point in the ordinary preſſure of the atmoſphere, it was reaſonable to expect that the temperature at which they ceaſed to emit ſenſibly elaſtic ſteam would have ſome relation to their temperatures when emitting ſteam of any determinate elaſticity. Now as the vapour of alcohol of elaſticity 30 has its temperature about 36° lower than the temperature of water equally elaſtic, it was to be expected that the temperature at which it ceaſed to be ſenſibly affected would be ſeveral degrees lower than 32°. It is evident, however, that this is not the caſe. But this is a point that deſerves more attention, becauſe it is cloſely connected with the chemical relation between the element (if ſuch there be) of fire and the bodies into whoſe compoſition it ſeems to enter as a conſtituent part. What is the temperature 32°, to make it peculiarly connected with elaſticity? It is a temperature aſſumed by us for our own conveniency, on account of the familiarity of water in our experiments. Æther, we know, boils in a temperature far below this, as appears from Dr Cullen's experiments narrated in the Eſſays Phyſical and Literary of Edinburgh. On the faith of former experiments, we may be pretty certain that it will boil in vacuo at the temperature −14°, becauſe in the air it boils at +106°. Therefore we may be certain, that the ſteam or vapour of æther, when of the temperature 32°, will be very ſenſibly elaſtic. Indeed Mr Lavoiſier ſays, that if it be expoſed in an exhauſted receiver in winter, its vapour will ſupport mercury at the height of 10 inches. A ſeries of experiments on this vapour ſimilar to the above would be very inſtructive. We even wiſh that thoſe on alcohol were more carefully repeated. If we draw a curve line, of which the abſciſſa is the line of temperatures, and the ordinates are the correſponding heights of the mercury in theſe experiments on water and alcohol, we ſhall obſerve, that although they both ſenſibly coincide at 32°, and have the abſciſſa for their common tangent, a very ſmall error of obſervation may be the cauſe of this, and the curve which expreſſes the elaſticity of ſpirituous vapour may really interſect the other, and go backwards conſiderably beyond 32°.

25 Theſe experiments give riſe to important reflections.

This range of experiments gives riſe to ſome curious and important reflections. We now ſee that no particular temperature is neceſſary for water aſſuming the form of permanently elaſtic vapour; and that it is highly probable that it aſſumes this form even at the temperature 32°; only its elaſticity is too ſmall to afford us any ſenſible meaſure. It is well known that even ice evaporates (ſee experiments to this purpoſe by Mr Wilſon in the Philoſophical Tranſactions, when a piece of poliſhed metal covered with hoar-froſt became perfectly clear by expoſing it to a dry froſty wind). Vol. lxx.

Even mercury evaporates, or is converted into elaſtic vapour, when all external preſſure is removed. The dim film which may frequently be obſerved in the upper part of a barometer which ſtands near a ſtream of air, is found to be ſmall globules of mercury ſticking to the inſide of the tube. They may be ſeen by the help of a magnifying glaſs, and are the beſt teſt of a well made barometer. They will be entirely removed by cauſing the mercury to riſe along the tube. It will lick them all up. They conſiſt of mercury which had evaporated in the void ſpace, and was afterwards condenſed by the cold glaſs. But the elaſticity is too ſmall to occaſion a ſenſible depreſſion of the column, even when conſiderably warmed by a candle.

26 Spontaneous evaporation produced by the diſſolving power of the air.

Many philoſophers accordingly imagine, that ſpontaneous evaporation in low temperatures is produced in this way. But we cannot be of this opinion, and muſt ſtill think that this kind of evaporation is produced by the diſſolving power of the air. When moiſt air is ſuddenly rarefied, there is always a precipitation of water. This is moſt diſtinctly ſeen when we work an air-pump briſkly. A miſt is produced, which we ſee plainly fall to the bottom of the receiver. But by this new doctrine the very contrary ſhould happen, becauſe the tendency of water to appear in the elaſtic form is promoted by removing the external preſſure; and we really imagine that more of it now actually becomes ſimple elaſtic watery vapour. But the miſt or precipitation ſhows incontrovertibly, that there had been a previous ſolution. Solution is performed by forces which act in the way of attraction; or, to expreſs it more ſafely, ſolutions are accompanied by the mutual approaches of the particles of the menſtruum and ſolvend: all ſuch tendencies are *obſerved* to increaſe by a diminution of diſtance. Hence it *muſt* follow, that air of double denſity will diſſolve more than twice as much water. Therefore when we ſuddenly rarefy ſaturated air (even tho' its

Steam. its heat ſhould not diminiſh) ſome water muſt be let go. What may be its quantity we know not; but it *may be more* than what would now become elaſtic by this diminution of ſurrounding preſſure; and it is not unlikely but this may have ſome effect in producing the veſicles which we found ſo difficult to explain. Theſe may be filled with pure watery vapour, and be floating in a fluid compoſed of water diſſolved in air. An experiment of Fontana's ſeems to put this matter out of doubt. A diſtilling apparatus AB (fig. 4.) was ſo contrived, that the heat was applied above the ſurface of the water in the alembic A. This was done by incloſing it in another veſſel CC, filled with hot water. In the receiver B there was a ſort of barometer D, with an open ciſtern, in order to ſee what preſſure there was on the ſurface of the fluid. While the receiver and alembic contained air, the heat applied at A produced no ſenſible diſtillation during ſeveral hours: But on opening a cock E in the receiver at its bottom, and making the water in the alembic to boil, ſteam was produced which ſoon expelled all the air, and followed it through the cock. The cock was now ſhut, and the whole allowed to grow cold by removing the fire, and applying cold water to the alembic. The barometer fell to a level nearly. Then warm water was allowed to get into the outer veſſel CC. The barometer roſe a little, and the diſtillation went on briſkly without the ſmalleſt ebullition in the alembic. The concluſion is obvious: while there was air in the receiver and communicating pipe, the diſtillation proceeded entirely by the diſſolving power of this air. Above the water in the alembic it was quickly ſaturated; and this ſaturation proceeded ſlowly along the ſtill air in the communicating pipe, and at laſt might take place thro' the whole of the receiver. The ſides of the receiver being kept cold, ſhould condenſe part of the water diſſolved in the air in contact with them, and this ſhould trickle down the ſides and be collected. But any perſon who has obſerved how long a cryſtal of blue vitriol will lie at the bottom of a glaſs of ſtill water before the tinge will reach the ſurface, will ſee that it muſt be next to impoſſible for diſtillation to go on in theſe circumſtances; and accordingly none was obſerved. But when the upper part of the apparatus was filled with pure watery vapour, it was ſupplied from the alembic as faſt as it was condenſed in the receiver, juſt as in the pulſe glaſs.

27 A certain law in the dilatation of aeriform fluids by heat.

Another inference which may be drawn from theſe experiments is, that Nature ſeems to affect a certain law in the dilatation of aeriform fluids by heat. They ſeem to be dilatable nearly in proportion of their preſent dilatation. For if we ſuppoſe that the vapours reſemble air, in having their elaſticity in any given temperature proportional to their denſity, we muſt ſuppoſe that if ſteam of the elaſticity 60, that is, ſupporting 60 inches of mercury, were ſubjected to a preſſure of 30 inches, it would expand into twice its preſent bulk. The augmentation of elaſticity therefore is the meaſure of the bulk into which it would expand in order to acquire its former elaſticity. Taking the increaſe of elaſticity therefore as a meaſure of the bulk into which it would expand under one conſtant preſſure, we ſee that equal increments of temperature produce nearly equal multiplications of bulk. Thus if a certain diminution of temperature diminiſhes its bulk $\frac{1}{4}$th, another equal diminution of temperature will diminiſh this new bulk $\frac{1}{4}$th very nearly. Thus, in our experiments, the temperatures 110°, 140° 170°, 200°, 230°, are in arithmetical progreſſion, having equal differences; and we ſee that the correſponding elaſticities 2,25, 5,15, 11,05, 22,62, 44,7, are very nearly in the continued proportion of 1 to 2. The elaſticity correſponding to the temperature 260 deviates conſiderably from this law, which would give 88 or 89 inſtead of 80; and the deviation increaſes in the higher temperatures. But ſtill we ſee that there is a conſiderable approximation to this law; and it will frequently aſſiſt us to recollect, that whatever be the preſent temperature, an increaſe of 30 degrees doubles the elaſticity and the bulk of watery vapour. Steam.

That	4°	will increaſe the elaſticity from	1 to $1\frac{1}{10}$
	8		1 to $1\frac{1}{5}$
	10		1 to $1\frac{1}{4}$
	$12\frac{1}{2}$		1 to $1\frac{1}{3}$
	18		1 to $1\frac{1}{2}$
	22		1 to $1\frac{2}{3}$
	24		1 to $1\frac{3}{4}$
	26		1 to $1\frac{4}{5}$

This is ſufficiently exact for moſt practical purpoſes. Thus an engineer finds that the injection cools the cylinder of a ſteam-engine to 192°. It therefore leaves a ſteam whoſe elaſticity is $\frac{1}{5}$ths of its full elaſticity, = 18 inches ☿. But it is better at all times to have recourſe to the table. Obſerve, too, that in the lower temperatures, *i. e.* below 110°, this increment of temperature does more than double the elaſticity.

28 Obtains more remarkably in the incoercible vapours,

This law obtains more remarkably in the incoercible vapours; ſuch as vital air, atmoſpheric air, fixed air, &c. all of which have alſo their elaſticity proportional to their bulk inverſely: and perhaps the deviation from the law in ſteams is connected with their chemical difference of conſtitution. If the bulk were always augmented in the ſame proportion by equal augmentations of temperature, the elaſticities would be accurately repreſented by the ordinates of a logarithmic curve, of which the temperatures are the correſponding abſciſſæ; and we might contrive ſuch a ſcale for our thermometer, that the temperatures would be the common logarithms of the elaſticities, or of the bulks having equal elaſticity; or, with our preſent ſcale, we may find ſuch a multiplier m for the number x of degrees of our thermometer (above that temperature where the elaſticity is equal to unity), that this multiple ſhall be the common logarithm of the elaſticity y; ſo that $mx = \log. y$.

But our experiments are not ſufficiently accurate for determining the temperature where the elaſticity is meaſured by 1 inch; becauſe in theſe temperatures the elaſticities vary by exceedingly ſmall quantities. But if we take 11,04 for the unit of elaſticity, and number our temperature from 170°, and make $m = 0{,}010035$, we ſhall find the product mx to be very nearly the logarithm of the elaſticity. The deviations, however, from this law, are too great to make this equation of any uſe. But it is very practicable to frame an equation which ſhall correſpond with the experiments to any degree of accuracy; and it has been done for air in a tranſlation of General Roy's Meaſurement of the Baſe at Hounſlow Heath into French by Mr Prony. It is as follows: Let x be the degrees of Reaumur's

Steam.

thermometer; let y be the expanſion of 10,000 parts of air; let e be $= 10$, $m = 2{,}7976$, $n = 0{,}01768$: then $y = e^{m+nx} - 627{,}5$. Now e being $= 10$, it is plain that e^{m+nx} is the number, of which $m + nx$ is the common logarithm. This formula is very exact as far as the temperature 60°: but beyond this it needs a correction; becauſe air, like the vapour of water, does not expand in the exact proportion of its bulk.

29 And is conſiderably approximated to in the augmentation of the bulk or elaſticity of elaſtic vapours.

We obſerve this law conſiderably approximated to in the augmentation of the bulk or elaſticity of elaſtic vapours; that is, it is a fact that a given increment of temperature makes very nearly the ſame proportional augmentation of bulk and elaſticity. This gives us ſome notion of the manner in which the ſuppoſed expanding cauſe produces the effect. When vapour of the bulk 4 is expanded into a bulk 5 by an addition of 10 degrees of ſenſible heat, a certain quantity of fire goes into it, and is accumulated round each particle, in ſuch a manner that the temperature of each, which formerly was m, is now $m+10$. Let it now receive another equal augmentation of temperature. This is now $m+20$, and the bulk is $\frac{5\times5}{4}$ or $6\frac{1}{4}$, and the arithmetical increaſe of bulk is $1\frac{1}{4}$. The abſolute quantity of fire which has entered it is greater than the former, both on account of the greater augmentation of ſpace and the greater temperature. Conſequently if this vapour be compreſſed into the bulk 5, there muſt be heat or fire in it which is not neceſſary for the temperature $m + 20$, far leſs for the temperature $m + 10$. It muſt therefore emerge, and be diſpoſed to enter a thermometer which has already the temperature $m + 20$: that is, the vapour muſt grow hotter by compreſſion; not by ſqueezing out the heat, like water out of a ſponge, but becauſe the law of attraction for heat is deranged. It would be a very valuable acquiſition to our knowledge to learn with preciſion the quantity of ſenſible heat produced in this way; but no ſatisfactory experiments have yet been made. M. Lavoiſier, with his chemical friends and colleagues, were buſily employed in this inquiry; but the wickedneſs of their countrymen has deprived the world of this and many other important additions which we might have expected from this celebrated and unfortunate philoſopher. He had made, in conjunction with M. de la Place, a numerous train of accurate and expenſive experiments for meaſuring the quantity of latent or combined heat in elaſtic vapours. This is evidently a very important point to the diſtiller and practical chemiſt. This heat muſt all come from the fuel; and it is greatly worth while to know whether any ſaving may be made of this article. Thus we know that diſtillation will go on either under the preſſure of the air, or in an alembic and receiver from which the air has been expelled by ſteam; and we know that this laſt may be conducted in a very low temperature, even not exceeding that of the human body. But it is uncertain whether this may not employ even a greater quantity of fuel, as well as occaſion a great expence of time. We are diſpoſed to think, that when there is no air in the apparatus, and when the condenſation can be ſpeedily performed, the proportion of fuel expended to the fluid which comes over will diminiſh continually as the heat, and conſequently the denſity of the ſteam, is augmented; becauſe in this caſe the quantity of combined heat muſt be leſs. In the mean time, we earneſtly recommend the trial of this mode of diſtillation in veſſels cleared of air. It is undoubtedly of great advantage to be able to work with ſmaller fires; and it would ſecure us againſt all accidents of blowing off the head of the ſtill, often attended with terrible conſequences (B).

Steam.

We muſt not conclude this article without taking notice of ſome natural phenomena which ſeem to owe their origin to the action of elaſtic ſteam.

We have already taken notice of the reſemblance of the tremor and ſuccuſſions obſerved in the ſhocks of many earthquakes to thoſe which may be felt in a veſſel where water is made to boil internally, while the breaking out of the ebullition is ſtifled by the cold of the upper parts; and we have likewiſe ſtated the objections which are uſually made to this theory of earthquakes. We may perhaps reſume the ſubject under the article VOLCANO; but in the mean time we do not heſitate to ſay, that the wonderful appearances of the Geyzer ſpring in Iceland (ſee HUER; and ICELAND, n° 3—5.) are undoubtedly produced by the expanſion of ſteam in ignited caverns. Of theſe appearances we ſuppoſe the whole train to be produced as follows.

30 Explanation of the phenomena of the Geyzer ſpring in Iceland by the force of ſteam.

A cavern may be ſuppoſed of a ſhape analogous to CBDEF (fig. 5.), having a perpendicular funnel AB iſſuing from a depreſſed part of the roof. The part F may be lower than the reſt, remote, and red-hot. Such places we know to be frequent in Iceland. Water may be continually trickling into the part CD. It will fill it up to B, and even up to E e, and then trickle ſlowly along into F. As ſoon as any gets into contact with an ignited part, it expands into elaſtic ſteam, and is partly condenſed by the cold ſides of the cavern, which it gradually warms, till it condenſes no more. This

produc

(B) We earneſtly recommend this ſubject to the conſideration of the philoſopher. The laws which regulate the formation of elaſtic vapour, or the general phenomena which it exhibits, give us that link which connects chemiſtry with mechanical philoſophy. Here we ſee chemical affinities and mechanical forces ſet in immediate oppoſition to each other, and the one made the indication, characteriſtic, and meaſure of the other. We have not the leaſt doubt that they make but one ſcience, the Science of Univerſal Mechanics; nor do we deſpair of ſeeing the phenomena of ſolution, precipitation, cryſtallization, fermentation, nay animal and vegetable ſecretion and aſſimilation, ſucceſsfully inveſtigated, as caſes of local motion, and explained by the agency of central forces. Some thing of this kind, and that not inconſiderable, was done when Dr Cullen firſt ſhowed how the double affinities might be illuſtrated by the aſſiſtance of numbers. Dr Black gave to this hint (for it was little more) that elegant preciſion which characterizes all his views. Mr Kirwan has greatly promoted this ſtudy by his numerous and ingenious examples of its application; and the moſt valuable paſſages of the writings of Mr Lavoiſier, are thoſe where he traces with logical preciſion the balancings of force which appear in the chemical phenomena. It is from the ſimilar balancings and conſequent meaſurements, which may be obſerved and obtained in the preſent caſe, that we are to hope for admiſſion into this almoſt unbounded ſcience of contemplation. We have another link equally intereſting and promiſing, viz. the production of heat by friction. This alſo highly deſerves the conſideration of the mathematical philoſopher.

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production of ſteam hinders not in the ſmalleſt degree the trickling of more water into F, and the continual production of more ſteam. This now preſſes on the ſurface of the water in CD, and cauſes it to riſe gradually in the funnel BA; but ſlowly, becauſe its cold ſurface is condenſing an immenſe quantity of ſteam. We may eaſily ſuppoſe that the water trickles faſter into F than it is expended in the production of ſteam; ſo that it reaches farther into the ignited part, and may even fall in a ſtream into ſome deeper pit highly ignited. It will now produce ſteam in vaſt abundance, and of prodigious elaſticity; and at once puſh up the water thro' the funnel in a ſolid jet, and to a great height. This muſt continue till the ſurface of the water ſinks to BD. If the lower end of the funnel have any inequalities or notches, as is moſt likely, the ſteam will get admiſſion along with the water, which in this particular place is boiling hot, being ſuperficial, and will get to the mouth of the funnel, while water is ſtill preſſed in below. At laſt the ſteam gets in at B on all ſides; and as it is converging to B, along the ſurface of the water, with prodigious velocity it ſweeps along with it much water, and blows it up through the funnel with great force. When this is over, the remaining ſteam blows out unmixed with water, growing weaker as it is expended, till the bottom of the funnel is again ſtopped by the water increaſing in the cavern CBD. All the phenomena above ground are perfectly conformable to the neceſſary conſequences of this very probable conſtruction of the cavern. The feeling of being lifted up, immediately before the jet, in all probability is owing to a real heaving up of the whole roof of the cavern by the firſt expanſion of the great body of ſteam. We had an accurate deſcription of the phenomena from perſons well qualified to judge of theſe matters who viſited theſe celebrated ſprings in 1789.

Steam-Engine, is the name of a machine which derives its moving power from the elaſticity and condenſibility of the ſteam of boiling water. It is the moſt valuable preſent which the arts of life have ever received from the philoſopher. The mariner's compaſs, the teleſcope, gunpowder, and other moſt uſeful ſervants to human weakneſs and ingenuity, were the productions of chance, and we do not exactly know to whom we are indebted for them; but the ſteam-engine was, in the very beginning, the reſult of reflection, and the production of a very ingenious mind; and every improvement it has received, and every alteration in its conſtruction and principles, were alſo the reſults of philoſophical ſtudy.

1 Steam-engine invented by the Marquis of Worceſter.

The ſteam-engine was beyond all doubt invented by the marquis of Worceſter during the reign of Cha. II. This nobleman publiſhed in 1663 a ſmall book intitled A Century of Inventions; giving ſome obſcure and enigmatical account of an hundred diſcoveries or contrivances of his own, which he extols as of great importance to the public. He appears to have been a perſon of much knowledge and great ingenuity: but his deſcription or accounts of theſe inventions ſeem not ſo much intended to inſtruct the public, as to raiſe wonder; and his encomiums on their utility and importance are to a great degree extravagant, reſembling more the puff of an advertiſing tradeſman than the patriotic communications of a gentleman. The marquis of Worceſter was indeed a projector, and very importunate and myſterious withal in his applications for public encouragement. His account, however, of the ſteam-engine, although by no means fit to give us any diſtinct notions of its ſtructure and operation, is exact as far as it goes, agreeing preciſely with what we now know of the ſubject. It is N° 68. of his inventions. His words are as follow: "This admirable method which I propoſe of raiſing water by the force of fire has no bounds if the veſſels be ſtrong enough: for I have taken a cannon, and having filled it ¾ths full of water, and ſhut up its muzzle and touch-hole, and expoſed it to the fire for 24 hours, it burſt with a great exploſion. Having afterwards diſcovered a method of fortifying veſſels internally, and combined them in ſuch a way that they filled and acted alternately, I have made the water ſpout in an uninterrupted ſtream 40 feet high; and one veſſel of rarefied water raiſed 40 of cold water. The perſon who conducted the operation had nothing to do but turn two cocks; ſo that one veſſel of water being conſumed, another begins to force, and then to fill itſelf with cold water, and ſo on in ſucceſſion."

2 But firſt reduced to practice by Captain Savary.

It does not appear that the noble inventor could ever intereſt the public by theſe accounts. His character as a projector, and the many failures which perſons of this turn of mind daily experience, probably prejudiced people againſt him, and prevented all attention to his projects. It was not till towards the end of the century, when experimental philoſophy was proſecuted all over Europe with uncommon ardour, that theſe notions again engaged attention. Captain Savary, a perſon alſo of great ingenuity and ardent mind, ſaw the reality and practicability of the marquis of Worceſter's project. He knew the great expanſive power of ſteam, and had diſcovered the inconceivable rapidity with which it is reconverted into water by cold; and he ſoon contrived a machine for raiſing water, in which both of theſe properties were employed. He ſays, that it was entirely his own invention. Dr Deſaguliers inſiſts that he only copied the marquis's invention, and charges him with groſs plagiariſm, and with having bought up and burned the copies of the marquis's book, in order to ſecure the honour of the diſcovery to himſelf. This is a very grievous charge, and ſhould have been ſubſtantiated by very diſtinct evidence. Deſaguliers produces none ſuch; and he was much too late to know what happened at that time. The argument which he gives is a very fooliſh one, and gave him no title to conſider Savary's experiment as a falſehood; for it might have happened preciſely as Savary relates, and not as it happened to Deſaguliers. The fact is, that Savary obtained his patent of invention after a hearing of objections, among which the diſcovery of the marquis of Worceſter was not mentioned: and it is certain that the account given in the Century of Inventions could inſtruct no perſon who was not ſufficiently acquainted with the properties of ſteam to be able to invent the machine himſelf.

3 Papin has no claim to the invention as the French pretend.

Captain Savary obtained his patent *after having actually erected* ſeveral machines, of which he gave a deſcription in a book intitled The Miner's Friend, publiſhed in 1696, and in another work publiſhed in 1699. Much about this time Dr Papin, a Frenchman and fellow of the Royal Society, invented a method of diſſolving bones and other animal ſolids in water, by confining

6 them

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them in close vessels, which he called DIGESTERS, so as to acquire a great degree of heat. For it must be observed in this place, that it had been discovered long before (in 1684) by Dr Hooke, the most inquisitive experimental philosopher of that inquisitive age, that water could not be made to acquire above a certain temperature in the open air; and that as soon as it begins to boil, its temperature remains fixed, and an increase of heat only produces a more violent ebullition, and a more rapid waste. But Papin's experiments made the elastic power of steam very familiar to him: and when he left England and settled as professor of mathematics at Marpurgh, he made many aukward attempts to employ this force in mechanics, and even for raising water. It appears that he had made experiments with this view in 1698, by order of Charles Landgrave of Hesse. For this reason the French affect to consider him as the inventor of the steam-engine. He indeed published some account of his invention in 1707; but he acknowledges that Captain Savary had also, and without any communication with him, invented the same thing. Whoever will take the trouble of looking at the description which he has given of these inventions, which are to be seen in the *Acta Eruditorum, Lipsiæ*, and in Leupold's *Theatrum Machinarum*, will see that they are most aukward, absurd, and impracticable. His conceptions of natural operations were always vague and imperfect, and he was neither philosopher nor mechanician.

We are thus anxious about the claim of those gentlemen, because a most respectable French author, Mr Bossut, says in his *Hydrodynamique*, that the first notion of the steam-engine was *certainly* owing to Dr Papin, who had not only invented the digester, but had in 1695 published a little performance describing a machine for raising water, in which the pistons are moved by the vapour of boiling water alternately dilated and condensed. Now the fact is, that Papin's first publication was in 1707, and his piston is nothing more than a floater on the surface of the water, to prevent the waste of steam by condensation; and the return of the piston is not produced, as in the steam-engine, by the condensation of the steam, but by admitting the air and a column of water to press it back into its place. The whole contrivance is so aukward, and so unlike any distinct notions of the subject, that it cannot do credit to any person. We may add, that much about the

4
Mr Amontons's fire-wheel.

same time Mr Amontons contrived a very ingenious but intricate machine, which he called a *fire-wheel*. It consisted of a number of buckets placed in the circumference of a wheel, and communicating with each other by very intricate circuitous passages. One part of this circumference was exposed to the heat of a furnace, and another to a stream or cistern of cold water. The communications were so disposed, that the steam produced in the buckets on one side of the wheel drove the water into buckets on the other side, so that one side of the wheel was always much heavier than the other; and it must therefore turn round, and may execute some work. The death of the inventor, and the intricacy of the machine, caused it to be neglected. Another member of the Parisian academy of sciences (Mr Deslandes) also presented to the academy a project of a steam-wheel, where the impulsive force of the vapour was employed; but it met with no encouragement.

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The English engineers had by this time so much improved Savary's first invention, that it supplanted all others. We have therefore no hesitation in giving the honour of the first and complete invention to the marquis of Worcester; and we are not disposed to refuse Captain Savary's claim to originality as to the construction of the machine, and even think it probable that his own experiments made him see the whole independent of the marquis's account.

Captain Savary's engine, as improved and simplified by himself, is as follows.

5
Captain Savary's steam-engine described.

Plate CCCCLXXVII

A (fig. 6.) represents a strong copper boiler properly built up in a furnace. There proceeds from its top a large steam-pipe B, which enters into the top of another strong vessel R called the RECEIVER. This pipe has a cock at C called the STEAM-COCK. In the bottom of the receiver is a pipe F, which communicates sidewise with the rising pipe KGH. The lower end H of this pipe is immersed in the water of the pit or well, and its upper part K opens into the cistern into which the water is to be delivered. Immediately below the pipe of communication F there is a valve G, opening when pressed from below, and shutting when pressed downwards. A similar valve is placed at I, immediately above the pipe of communication. Lastly, there is a pipe ED which branches off from the rising pipe, and enters into the top of the receiver. This pipe has a cock D called the INJECTION-COCK. The mouth of the pipe ED has a nozzle *f* pierced with small holes, pointing from a centre in every direction. The keys of the two cocks C and D are united, and the handle *g h* is called the REGULATOR.

Let the regulator be so placed that the steam-cock C is open and the injection-cock D is shut; put water into the boiler A, and make it boil strongly. The steam coming from it will enter the receiver, and gradually warm it, much steam being condensed in producing this effect. When it has been warmed so as to condense no more, the steam proceeds into the rising pipe; the valve G remains shut by its weight; the steam lifts the valve I, and gets into the rising pipe, and gradually warms it. When the workman feels this to be the case, or hears the rattling of the valve I, he immediately turns the steam-cock so as to shut it, the injection-cock still remaining shut (at least we may suppose this for the present). The apparatus must now cool, and the steam in the receiver collapses into water. There is nothing now to balance the pressure of the atmosphere; the valve I remains shut by its weight; but the air incumbent on the water in the pit presses up this water through the suction-pipe HG, and causes it to lift the valve G, and flow into the receiver R, and fill it to the top, if not more than 20 or 25 feet above the surface of the pit water.

The steam-cock is now opened. The steam which, during the cooling of the receiver, has been accumulating in the boiler, and acquiring a great elasticity by the action of the fire, now rushes in with great violence, and, pressing on the surface of the water in the receiver, causes it to shut the valve G and open the valve I by its weight alone, and it now flows into the rising pipe, and would stand on a level if the elasticity of the steam were no more than what would balance the atmospherical pressure. But it is much more than this, and therefore is *press*s the water out of the receiver into the rising

pipe,

Steam-Engine.

pipe, and will even cauſe it to come out at K, if the elaſticity of the ſteam is ſufficiently great. In order to enſure this, the boiler has another pipe in its top, covered with a *ſafety*-valve V, which is kept down by a weight W ſuſpended on a ſteelyard L M. This weight is ſo adjuſted that its preſſure on the ſafety-valve is ſomewhat greater than the preſſure of a column of water V*k* as high as the point of diſcharge K. The fire is ſo regulated that the ſteam is always iſſuing a little by the loaded valve V. The workman keeps the ſteam-valve open till he hears the valve I rattle. This tells him that the water is all forced out of the receiver, and that the ſteam is now following it. He immediately turns the regulator which ſhuts the ſteam-cock, and now, for the firſt time, opens the injection-cock. The cold water trickles at firſt through the holes of the nozzle *f*, and falling down through the ſteam, begins to condenſe it; and then its elaſticity being leſs than the preſſure of the water in the pipe K E D *f*, the cold water ſpouts in all directions through the nozzle, and, quick as thought, produces a complete condenſation. The valve G now opens again by the preſſure of the atmoſphere on the water of the pit, and the receiver is ſoon filled with cold water. The injection-cock is now ſhut, and the ſteam-cock opened, and the whole operation is now repeated; and ſo on continually.

This is the ſimple account of the proceſs, and will ſerve to give the reader an introductory notion of the operation; but a more minute attention muſt be paid to many particulars before we can ſee the properties and defects of this ingenious machine.

6 Defects of this machine ſuch,

The water is driven along the riſing pipe by the elaſticity of the ſteam. This muſt in the boiler, and every part of the machine, exert a preſſure on every ſquare inch of the veſſels equal to that of the upright column of water. Suppoſe the water to be raiſed 100 feet, about 25 of this may be done in the ſuction-pipe; that is, the upper part of the receiver may be about 25 feet above the ſurface of the pit-water. The remaining 75 muſt be done by forcing, and every ſquare inch of the boiler will be ſqueezed out by a preſſure of more than 30 pounds. This very moderate height therefore requires very ſtrong veſſels; and the Marquis of Worceſter was well aware of the danger of their burſting. A copper boiler of ſix feet diameter muſt be $\frac{9}{10}$ths of an inch thick to be juſt in equilibrio with this preſſure: and the ſoldered joint will not be able to withſtand it, eſpecially in the high temperature to which the water muſt be heated in order to produce ſteam of ſufficient elaſticity. By conſulting the table of the elaſticity of ſteam deduced from our experiments mentioned in the preceding article, we ſee that this temperature muſt be at leaſt 280° of Fahrenheit's thermometer. In this heat ſoft ſolder is juſt ready to melt, and has no tenacity; even ſpelter ſolder is conſiderably weakened by it. Accordingly, in a machine erected by Captain Savary at York Buildings in London, the workman having loaded the ſafety-valve a little more than uſual to make the engine work more briſkly, the boiler burſt with a dreadful exploſion, and blew up the furnace and adjoining parts of the building as if it had been gunpowder. Mr Savary ſucceeded pretty well in raiſing moderate quantities of water to ſmall heights, but could make nothing of deep mines. Many attempts were made, on the Marquis's principle, to ſtrengthen the veſſels from within by radiated bars and by hoops, but in vain. Very ſmall boilers or evaporators were then tried, kept red-hot, or nearly ſo, and ſupplied with a ſlender ſtream of water trickling into them; but this afforded no opportunity of making a collection of ſteam during the refrigeration of the receiver, ſo as to have a magazine of ſteam in readineſs for the next forcing operation; and the working of ſuch machines was always an employment of great danger and anxiety.

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7 That it can be employed with advantage only in certain ſituations.

The only ſituation in which this machine could be employed with perfect ſafety, and with ſome effect, was where the whole lift did not exceed 30 or 35 feet. In this caſe the greateſt part of it was performed by the ſuction-pipe, and a very manageable preſſure was ſufficient for the reſt. Several machines of this kind were erected in England about the beginning of this century. A very large one was erected at a ſalt-work in the ſouth of France. Here the water was to be raiſed no more than 18 feet. The receiver was capacious, and it was occaſionally ſupplied with ſteam from a ſmall ſalt-pan conſtructed on purpoſe with a cover. The entry of the ſteam into the receiver merely allowed the water to run out of it by a large valve, which was opened by the hand, and the condenſation was produced by the help of a ſmall forcing pump alſo worked by the hand. In ſo particular a ſituation as this (and many ſuch may occur in the endleſs variety of human wants), this is a very powerful engine; and having few moving and rubbing parts, it muſt be of great durability. This circumſtance has occaſioned much attention to be given to this firſt form of the engine, even long after it was ſupplanted by thoſe of a much better conſtruction. A very ingenious attempt was made very lately to adapt this conſtruction to the uſes of the miners. The whole depth of the pit was divided into lifts of 15 feet, in the ſame manner as is frequently done in pump-machines. In each of theſe was a ſuction-pipe 14 feet long, having above it a ſmall receiver like R, about a foot high, and its capacity ſomewhat greater than that of the pipe. This receiver had a valve at the head of the ſuction-pipe, and another opening outwards into the little ciſtern, into which the next ſuction-pipe above dipped to take in water. Each of theſe receivers ſent up a pipe from its top, which all met in the cover of a large veſſel above ground, which was of double the capacity of all the receivers and pipes. This veſſel was cloſe on all ſides. Another veſſel of equal capacity was placed immediately above it, with a pipe from its bottom paſſing through the cover of the lower veſſel and reaching near to its bottom. This upper veſſel communicates with the boiler, and conſtitutes the receiver of the ſteam-engine. The operation is as follows: The lower veſſel is full of water. Steam is admitted into the upper veſſel, which expels the air by a valve, and fills the veſſel. It is then condenſed by cold water. The preſſure of the atmoſphere would cauſe it to enter by all the ſuction-pipes of the different lifts, and preſs on the ſurface of the water in the lower receiver, and force it into the upper one. But becauſe each ſuction-pipe dips in a ciſtern of water, the air preſſes this water before it, raiſes it into each of the little receivers which it fills, and allows the ſpring of the air (which was formerly in them, but which now paſſes up into the lower receiver) to force the water out of the lower receiver into the

Steam-Engine.

upper one. When this has been completed, the ſteam is again admitted into the upper receiver. This allows the water to run back into the lower receiver, and the air returns into the ſmall receivers in the pit, and allows the water to run out of each into its proper ciſtern. By this means the water of each pipe has been raiſed 15 feet. The operation may thus be repeated continually.

The contrivance is ingenious, and ſimilar to ſome which are to be met with in the hydraulics of Schottus, Sturmius, and other German writers. But the operation muſt be exceedingly ſlow; and we imagine that the expence of ſteam muſt be great, becauſe it muſt fill a very large and very cold veſſel, which muſt waſte a great portion of it by condenſation. We ſee by ſome late publications of the very ingenious Mr Blackey, that he is ſtill attempting to maintain the reputation of this machine by ſome contrivance of this kind; but we imagine that they will be ineffectual, except in ſome very particular ſituations.

8 Occaſions great waſte of ſteam and fuel.

For the great defect of the machine, even when we can ſecure it againſt all riſk of burſting, is the prodigious waſte of ſteam, and conſequently of fuel. Daily experience ſhows, that a few ſcattered drops of cold water is ſufficient for producing an almoſt inſtantaneous condenſation of a great quantity of ſteam. Therefore when the ſteam is admitted into the receiver of Savary's engine, and comes into contact with the cold top and cold water, it is condenſed with great rapidity; and the water does not *begin* to ſubſide till its ſurface has become ſo hot that it condenſes no more ſteam. It may now begin to yield to the preſſure of the incumbent ſteam; but as ſoon as it deſcends a little, more of the cold ſurface of the receiver comes into contact with the ſteam, and condenſes more of it, and the water can deſcend no farther till this addition of cold ſurface is heated up to the ſtate of evaporation. This rapid condenſation goes on all the while the water is deſcending. By ſome experiments frequently repeated by the writer of this article, it appears that no leſs than $\frac{1}{11}$ths of the whole ſteam is uſeleſsly condenſed in this manner, and not more than $\frac{1}{11}$th is employed in allowing the water to deſcend by its own weight; and he has reaſon to think that the portion thus waſted will be conſiderably greater, if the ſteam be employed to *force* the water out of the receiver to any conſiderable height.

Obſerve, too, that all this waſte muſt be repeated in every ſucceeding ſtroke; for the whole receiver muſt be cooled again in order to fill itſelf with water.

9 The attempts made to diminiſh this waſte unſucceſsful.

Many attempts have been made to diminiſh this waſte; but all to little purpoſe, becauſe the very filling of the receiver with cold water occaſions its ſides to condenſe a prodigious quantity of ſteam in the ſucceeding ſtroke. Mr Blackey has attempted to leſſen this by uſing two receivers. In the firſt was oil; and into this only the ſteam was admitted. This oil paſſed to and fro between the two receivers, and never touched the water except in a ſmall ſurface. But this hardly produced a ſenſible diminution of the waſte: for it muſt now be obſerved, that there is a neceſſity for the firſt cylinder's being cooled to a conſiderable degree below the boiling point; otherwiſe, though it will condenſe much ſteam, and allow the water to riſe into the receiver, there will be a great diminution of the height of ſuction, unleſs the veſſel be much cooled. This appears plainly by inſpecting the table of elaſticity. Thus, if the veſſel be cooled no lower than 180°, we ſhould loſe one half of the preſſure of the atmoſphere; if cooled to 120, we ſhould ſtill loſe $\frac{1}{10}$th. The inſpection of this table is of great uſe for underſtanding and improving this noble machine; and without a conſtant recollection of the elaſticity of ſteam correſponding to its actual heat, we ſhall never have a notion of the niceties of its operation.

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10 The aſtoniſhing rapidity with which ſteam is condenſed.

The rapidity with which the ſteam is condenſed is really aſtoniſhing. Experiments have been made on ſteam-veſſels of ſix feet in diameter and ſeven feet high; and it has been found, that about four ounces of water, as warm as the human blood, will produce a complete condenſation in leſs than a ſecond; that is, will produce all the condenſation that it is capable of producing, leaving an elaſticity about $\frac{1}{5}$th of the elaſticity of the air. In another experiment with the ſame ſteam-veſſel, no cold water was allowed to get into it, but it was made to communicate by a long pipe four inches in diameter with another veſſel immerſed in cold water. The condenſation was ſo rapid that the time could not be meaſured: it certainly did not exceed half a ſecond. Now this condenſation was performed by a very trifling ſurface of contact. Perhaps we may explain it a little in this way: When a maſs of ſteam, in immediate contact with the cold water, is condenſed, it leaves a void, into which the adjoining ſteam inſtantly expands; and by this very expanſion its capacity for heat is increaſed, or it grows cold, that is, abſtracts the heat from the ſteam ſituated immediately beyond it. And in this expanſion and refrigeration it is itſelf partly condenſed or converted into water, and leaves a void, into which the circumjacent ſteam immediately expands, and produces the ſame effect on the ſteam beyond it. And thus it may happen that the abſtraction of a ſmall quantity of heat from an inconſiderable maſs of ſteam may produce a condenſation which may be very extenſive. Did we know the change made in the capacity of ſteam for heat by a given change of bulk, we ſhould be able to tell exactly what would be the effect of this local actual condenſation. But experiment has not as yet given us any preciſe notions on this ſubject. We think that this rapid condenſation to a great diſtance by a very moderate actual abſtraction of heat is a proof that the capacity of ſteam for heat is prodigiouſly increaſed by expanſion. We ſay a *very moderate actual abſtraction* of heat, becauſe very little heat is neceſſary to raiſe four ounces of blood-warm water to a boiling temperature, which will unfit it for condenſing ſteam. The remarkable phenomenon of ſnow and ice produced in the Hungarian machine, when the air condenſed in the receiver is allowed to blow through the cock (ſee PNEUMATICS), ſhows this to be the caſe in moiſt air, that is, in air holding water in a ſtate of chemical ſolution. We ſee ſomething very like it in a thunder-ſtorm. A ſmall black cloud ſometimes appears in a particular ſpot, and in a very few ſeconds ſpreads over many hundred acres of ſky, that is, a precipitation of water goes on with that rapid diffuſion. We imagine that this increaſe of capacity or demand for heat, and the condenſation that muſt enſue if this demand is not ſupplied, is much more remarkable in pure watery vapours, and that this is a capital diſtinction of their conſtitution from vapours diſſolved in air.

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The reader muſt now be ſo well acquainted with what paſſes in the ſteam-veſſel, and with the exterior reſults from it, as readily to comprehend the propriety of the changes which we ſhall now deſcribe as having been made in the conſtruction and principle of the ſteam-engine.

11 Attempts to improve the ſteam-engine.

Of all places in England the tin-mines of Cornwall ſtood moſt in need of hydraulic aſſiſtance; and Mr Savary was much engaged in projects for draining them by his ſteam-engine. This made its conſtruction and principles well known among the machiniſts and engineers of that neighbourhood. Among theſe were a Mr Newcomen, an iron-monger or blackſmith, and Mr Cawley a glazier at Dartmouth in Devonſhire, who had dabbled much with this machine. Newcomen was a perſon of ſome reading, and was in particular acquainted with the perſon, writings, and projects of his countryman Dr Hooke. There are to be found among Hooke's papers, in the poſſeſſion of the Royal Society, ſome notes of obſervations, for the uſe of Newcomen his countryman, on Papin's boaſted method of tranſmitting to a great diſtance the action of a mill by means of pipes. Papin's project was to employ the mill to work two air-pumps of great diameter. The cylinders of theſe pumps were to communicate by means of pipes with equal cylinders furniſhed with piſtons, in the neighbourhood of a diſtant mine. Theſe piſtons were to be connected, by means of levers, with the piſton-rods of the mine. Therefore, when the piſton of the air-pump at the mill was drawn up by the mill, the correſponding piſton at the ſide of the mine would be preſſed down by the atmoſphere, and thus would raiſe the piſton-rod in the mine, and draw the water. It would appear from theſe notes, that Dr Hooke had diſſuaded Mr Newcomen from erecting a machine on this principle, of which he had expoſed the fallacy in ſeveral diſcourſes before the Royal Society. One paſſage is remarkable. "Could he (meaning Papin) make a ſpeedy vacuum under your ſecond piſton, your work is done."

It is highly probable that, in the courſe of this ſpeculation, it occurred to Mr Newcomen that the vacuum he ſo much wanted might be produced by ſteam, and that this gave riſe to his new principle and conſtruction of the ſteam-engine. The ſpecific deſideratum was in Newcomen's mind; and therefore, when Savary's engine appeared, and became known in his neighbourhood many years after, he would readily catch at the help which it promiſed.

Savary however claims the invention as his own; but Switzer, who was perſonally acquainted with both, is poſitive that Newcomen was the inventor. By his principles (as a quaker) being averſe from contention, he was contented to ſhare the honour and the profits with Savary, whoſe acquaintance at court enabled him to procure the patent in 1705, in which all the three were aſſociated. Poſterity has done juſtice to the modeſt inventor, and the machine is univerſally called Newcomen's Engine. Its principle and mode of operation may be clearly conceived as follows.

12 Deſcription of Newcomen's.

Let A (fig. 7.) repreſent a great boiler properly built in a furnace. At a ſmall height above it is a cylinder CBBC of metal, bored very truly and ſmoothly. The boiler communicates with this cylinder by means of the throat or ſteam-pipe NQ. The lower aperture of this pipe is ſhut by the plate N, which is ground very flat, ſo as to apply very accurately to the whole circumference of the orifice. This plate is called the regulator or ſteam-cock, and it turns horizontally round an axis *ba* which paſſes through the top of the boiler, and is nicely fitted to the ſocket, like the key of a cock, by grinding. The upper end of this axis is furniſhed with a handle *b* T.

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A piſton P is ſuſpended in this cylinder, and made air-tight by a packing of leather or ſoft rope, well filled with tallow; and, for greater ſecurity, a ſmall quantity of water is kept above the piſton. The piſton-rod PD is ſuſpended by a chain which is fixed to the upper extremity F of the arched head FD of the great lever or Working Beam HK, which turns on the gudgeon O. There is a ſimilar arched head EG at the other end of the beam. To its upper extremity E is fixed a chain carrying the pump-rod XL, which raiſes the water from the mine. The load on this end of the beam is made to exceed conſiderably the weight of the piſton P at the other extremity.

At ſome ſmall height above the top of the cylinder is a ciſtern W called the Injection Cistern. From this deſcends the Injection Pipe ZSR, which enters the cylinder through its bottom, and terminates in a ſmall hole R, or ſometimes in a nozzle pierced with many ſmaller holes diverging from a centre in all directions. This pipe has at S a cock called the Injection Cock, fitted with a handle V.

At the oppoſite ſide of the cylinder, a little above its bottom, there is a lateral pipe, turning upwards at the extremity, and there covered by a clack-valve *f*, called the Snifting Valve, which has a little diſh round it to hold water for keeping it air-tight.

There proceeds alſo from the bottom of the cylinder a pipe *d e g h* (paſſing behind the boiler), of which the lower end is turned upwards, and is covered with a valve *h*. This part is immerſed in a ciſtern of water Y, called the Hot Well, and the pipe itſelf is called the Eduction Pipe. Laſtly, the boiler is furniſhed with a ſafety-valve called the Puppet Clack (which is not repreſented in this ſketch for want of room), in the ſame manner as Savary's engine. This valve is generally loaded with one or two pounds on the ſquare inch, ſo that it allows the ſteam to eſcape when its elaſticity is $\frac{1}{10}$th greater than that of common air. Thus all riſk of burſting the boiler is avoided, and the preſſure outwards is very moderate; ſo alſo is the heat. For, by inſpecting the table of vaporous elaſticity, we ſee that the heat correſponding to 32 inches of elaſticity is only about 216° of Fahrenheit's thermometer.

These are all the eſſential parts of the engine, and are here drawn in the moſt ſimple form, till our knowledge of their particular offices ſhall ſhow the propriety of the peculiar forms which are given to them. Let us now ſee how the machine is put in motion, and what is the nature of its work.

13 How the machine is put in motion, and the nature of the work.

The water in the boiler being ſuppoſed to be in a ſtate of ſtrong ebullition, and the ſteam iſſuing by the ſafety-valve, let us conſider the machine in a ſtate of reſt, having both the ſteam-cock and injection cock ſhut. The reſting poſition or attitude of the machine muſt be ſuch as appears in this ſketch, the pump rods preponderating, and the great piſton being drawn up to the top of the cylinder. Now open the ſteam cock by turning the handle T of the regulator. The ſteam from the

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boiler will immediately ruſh in, and flying all over the cylinder, will mix with the air. Much of it will be condenſed by the cold ſurface of the cylinder and piſton, and the water produced from it will trickle down the ſides, and run off by the eduction-pipe. This condenſation and waſte of ſteam will continue till the whole cylinder and piſton are made as hot as boiling water. When this happens, the ſteam will begin to open the ſnifting valve *f*, and iſſue through the pipe; ſlowly at firſt and very cloudy, being mixed with much air. The blaſt at *f* will grow ſtronger by degrees, and more tranſparent, having already carried off the greateſt part of the common air which filled the cylinder. We ſuppoſed that the water was boiling briſkly, ſo that the ſteam was iſſuing by the ſafety-valve which is in the top of the boiler, and through every crevice. The opening of the ſteam-cock puts an end to this at once, and it has ſometimes happened that the cold cylinder abſtracts the ſteam from the boiler with ſuch aſtoniſhing rapidity, that the preſſure of the atmoſphere has burſt up the bottom of the boiler. We may here mention an accident of which we were witneſſes, which alſo ſhows the immenſe rapidity of the condenſation. The boiler was in a frail ſhed at the ſide of the engine-houſe; a ſhoot of ſnow from the top of the houſe fell down and broke through the roof of the ſhed, and was ſcattered over the head of the boiler, which was of an oblong or oval ſhape. In an inſtant the ſides of it were ſqueezed together by the preſſure of the atmoſphere.

When the manager of the engine perceives that not only the blaſt at the ſnifting valve is ſtrong and ſteady, but that the boiler is now fully ſupplied with ſteam of a proper ſtrength, appearing by the renewal of the diſcharge at the ſafety-valve, he ſhuts the ſteam-cock, and opens the injection-cock S by turning its handle V. The preſſure of the column of water in the injection-pipe ZS immediately forces ſome water through the ſpout R. This coming in contact with the pure vapour which now fills the cylinder, condenſes it, and thus makes a partial void, into which the more diſtant ſteam immediately expands, and by expanding collapſes (as has been already obſerved). What remains in the cylinder no longer balances the atmoſpherical preſſure on the ſurface of the water in the injection-ciſtern, and therefore the water ſpouts rapidly through the hole R by the joint action of the column ZS and the unbalanced preſſure of the atmoſphere; at the ſame time the ſnifting valve *f* and the eduction-valve *b* are ſhut by the unbalanced preſſure of the atmoſphere. The velocity of the injection water muſt therefore rapidly increaſe, and the jet will daſh (if ſingle) againſt the bottom of the piſton, and be ſcattered through the whole capacity of the cylinder. In a very ſhort ſpace of time, therefore, the condenſation of the ſteam becomes univerſal, and the elaſticity of what remains is almoſt nothing. The whole preſſure of the atmoſphere is exerted in the upper ſurface of the piſton, while there is hardly any on its under ſide. Therefore, if the load on the outer end E of the working beam is inferior to this preſſure, it muſt yield to it. The piſton P muſt deſcend, and the pump piſton L muſt aſcend, bringing along with it the water of the mine, and the motion muſt continue till the great piſton reaches the bottom of the cylinder; for it is not like the motion which would take place in a cylinder of air rarefied to the ſame degree. In this laſt caſe, the impelling force would be continually diminiſhed, becauſe the capacity of the cylinder is diminiſhed by the deſcent of the piſton, and the air in it is continually becoming more denſe and elaſtic. The piſton would ſtop at a certain height, where the elaſticity of the included air, together with the load at E, would balance the atmoſpherical preſſure on the piſton. But when the contents of the cylinder are pure vapour, and the continued ſtream of injected cold water keeps down its temperature to the ſame pitch as at the beginning, the elaſticity of the remaining ſteam can never increaſe by the deſcent of the piſton, nor exceed what correſponds to this temperature. The impelling or accelerating force therefore remains the ſame, and the deſcent of the piſton will be uniformly accelerated, if there is not an increaſe of reſiſtance ariſing from the nature of the work performed by the other end of the beam. This circumſtance will come under conſideration afterwards, and we need not attend to it at preſent. It is enough for our preſent purpoſe to ſee, that if the cylinder has been completely purged of common air before the ſteam-cock was ſhut, and if none has entered ſince, the piſton will deſcend to the very bottom of the cylinder. And this may be frequently obſerved in a good ſteam-engine where every part is air-tight. It ſometimes happens, by the pit-pump drawing air, or ſome part of the communication between the two ſtrains giving way, that the piſton comes down with ſuch violence as to knock out the bottom of the cylinder with the blow.

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14 The piſton does not begin to deſcend the moment the injection is made.

The only obſervation which remains to be made on the motion of the piſton in deſcending is, that it does not begin at the inſtant the injection is made. The piſton was kept at the top by the preponderancy of the outer end of the working beam, and it muſt remain there till the difference between the elaſticity of the ſteam below it and the preſſure of the atmoſphere exceeds this preponderancy. There muſt therefore be a ſmall ſpace of time between the beginning of the condenſation and the beginning of the motion. This is very ſmall, not exceeding the third or the fourth part of a ſecond; but it may be very diſtinctly obſerved by an attentive ſpectator. He will ſee, that the inſtant the injection-cock is opened, the cylinder will ſenſibly riſe upwards a little by the preſſure of the air on its bottom. Its whole weight is not nearly equal to this preſſure; and inſtead of its being neceſſary to *ſupport* it by a ſtrong floor, we muſt *keep it down* by ſtrong joiſts loaded by heavy walls. It is uſual to frame theſe joiſts into the poſts which carry the axis of the working-beam, and are therefore loaded with the whole ſtrain of the machine. This riſing of the cylinder ſhows the inſtantaneous commencement of the condenſation; and it is not till *after* this has been diſtinctly obſerved that the piſton is ſeen to ſtart, and begin to deſcend.

15 The circumſtances that ſucceed the deſcent of the piſton.

When the manager ſees the piſton as low as he thinks proper, he ſhuts the injection-cock, and opens the ſteam-cock. The ſteam has been accumulating above the water in the boiler during the whole time of the piſton's deſcent, and is now ruſhing violently through the puppet clack. The moment therefore that the ſteam-cock is opened, it ruſhes violently into the cylinder, having an elaſticity greater than that of the air. It therefore immediately blows open the ſnifting valve, and allows (at leaſt) the water which had come in by the former injection, and what aroſe from the condenſed

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fed ſteam, to deſcend by its own weight through the eduction-pipe *d e g h* to open the valve *h*, and to run out into the hot well. And we muſt eaſily ſee that this water is boiling hot; for while lying in the bottom of the cylinder, it will condenſe ſteam till it acquires this temperature, and therefore cannot run down till it condenſes no more. There is ſtill a waſte of ſteam at its firſt admiſſion, in order to heat the inſide of the cylinder and the injected water to the boiling temperature: but the ſpace being ſmall, and the whole being already very warm, this is very ſoon done; and when things are properly conſtructed, little more ſteam is wanted than what will warm the cylinder; for the eduction-pipe receives the injection water even during the deſcent of the piſton, and it is therefore removed pretty much out of the way of the ſteam.

16 Effects of the firſt puff of entering ſteam

This firſt puff of the entering ſteam is of great ſervice: it drives out of the cylinder the vapour which it finds there. This is ſeldom pure watery vapour: all water contains a quantity of air in a ſtate of chemical union. The union is but feeble, and a boiling heat is ſufficient for diſengaging the greateſt part of it by increaſing its elaſticity. It may alſo be diſengaged by ſimply removing the external preſſure of the atmoſphere. This is clearly ſeen when we expoſe a glaſs of water in an exhauſted receiver. Therefore the ſmall ſpace below the piſton contains watery vapour mixed with all the air which had been diſengaged from the water in the boiler by ebullition, and all that was ſeparated from the injection water by the diminution of external preſſures. All this is blown out of the cylinder by the firſt puff of ſteam. We may obſerve in this place, that waters differ exceedingly in the quantity of air which they hold in a ſtate of ſolution. All ſpring water contains much of it: and water newly brought up from deep mines contains a great deal more, becauſe the ſolution was aided in theſe ſituations by great preſſures. Such waters ſparkle when poured into a glaſs. It is therefore of great conſequence to the good performance of a ſteam-engine to uſe water containing little air, both in the boiler and in the injection-ciſtern. The water of running brooks is preferable to all others, and the freer it is from any ſaline impregnation it generally contains leſs air. Such engines as are ſo unfortunately ſituated that they are obliged to employ the very water which they have brought up from great depths, are found greatly interior in their performance to others. The air collected below the piſton greatly diminiſhes the accelerating force, and the expulſion of ſuch a quantity requires a long continued blaſt of the beſt ſteam at the beginning of every ſtroke. It is adviſable to keep ſuch water in a large ſhallow pond for a long while before uſing it.

17 Of great conſequence to the good performance of a ſteam-engine, that the water employed contain little air.

18 How the piſton riſes.

Let us now conſider the ſtate of the piſton. It is evident that it will ſtart or begin to riſe the moment the ſteam-cock is opened; for at that inſtant the exceſs of atmoſpherical preſſure, by which it was kept down in oppoſition to the preponderancy of the outer end of the beam, is diminiſhed. The piſton is therefore *dragged* upwards, and it will riſe even although the ſteam which is admitted be not ſo elaſtic as common air. Suppoſe the mercury in the barometer to ſtand at 30 inches, and that the preponderancy at the outer end of the beam is $\frac{1}{9}$th of the preſſure of the air on the piſton, the piſton will not riſe if the elaſticity of the ſteam is not equal to $30-\frac{30}{9}$, that is, to 26,7 inches nearly; but if it is juſt this quantity, the piſton will riſe as faſt as this ſteam can be ſupplied through the ſteam-pipe, and the velocity of its aſcent depends entirely on the velocity of this ſupply. This obſervation is of great importance; and it does not ſeem to have occurred to the mathematicians, who have paid moſt attention to the mechaniſm of the motion of this engine. In the mean time, we may clearly ſee that the entry of the ſteam depends chiefly on the counter weight at E: for ſuppoſe there was none, ſteam no ſtronger than air would not enter the cylinder at all; and if the ſteam be ſtronger, it will enter only by the exceſs of its ſtrength. Writers on the ſteam-engine (and even ſome of great reputation) familiarly ſpeak of the ſteam giving the piſton a puſh: But this is ſcarcely poſſible. During the riſe of the piſton the ſniting valve is never obſerved to blow; and we have not heard any well atteſted accounts of the piſton-chains ever being ſlackened by the upward preſſure of the ſteam, even at the very beginning of the ſtroke. During the riſing of the piſton the ſteam is (according to the common conception and manner of ſpeaking) *ſucked in*, in the ſame way that air is ſucked into a common ſyringe or pump when we draw up the piſton; for in the ſteam-engine the piſton is really drawn up by the counter weight. But it is ſtill more ſucked in, and requires a more copious ſupply, for another reaſon. As the piſton deſcended only in conſequence of the inſide of the cylinder's being ſufficiently cooled to condenſe the ſteam, this cooled ſurface muſt again be preſented to the ſteam during the riſe of the piſton, and muſt condenſe ſteam a ſecond time. The piſton cannot riſe another inch till the part of the cylinder which the piſton has already quitted has been warmed up to the boiling point, and ſteam muſt be expended in this warming. The inner ſurface of the cylinder is not only of the heat of boiling water while the piſton riſes, but is alſo perfectly dry; for the film of water left on it by the aſcending piſton muſt be completely evaporated, otherwiſe it will be condenſing ſteam. That the quantity thus waſted is conſiderable, appears by the experiments of Mr Beighton. He found that five pints of water were boiled off in a minute, and produced 16 ſtrokes of an engine whoſe cylinder contained 113 gallons of 282 inches each; and he thence concluded that ſteam was 2886 times rarer them water. But in no experiment made with ſcrupulous care on the expanſion of boiling water does it appear that the denſity of ſteam exceeds $\frac{1}{10,000}$th of the denſity of water. Deſaguliers ſays that it is above 14,000 times rarer than water. We have frequently attempted to meaſure the weight of ſteam which filled a very light veſſel, which held 12,600 grains of water, and found it always leſs than one grain; ſo that we have no doubt of its being much more than 10,000 times rarer than water. This being the caſe, we may ſafely ſuppoſe that the number of gallons of ſteam, inſtead of being 16 times 113, were nearly five times as much; and that only $\frac{1}{5}$th were employed in allowing the piſton to riſe, and the remaining $\frac{4}{5}$ths were employed to warm the cylinder.

19 Its aſcent chiefly owing to the weight of the pit piſton-rods.

The moving force during the aſcent of the piſton muſt be conſidered as reſulting chiefly, if not ſolely, from the preponderating weight of the pit piſton-rods. The office of this is to return the ſteam-piſton to the top

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top of the cylinder, where it may again be preſſed down by the air, and make another working ſtroke by raiſing the pump-rods. But the counter-weight at E has another ſervice to perform in this uſe of the engine; namely, to return the pump piſtons into their places at the bottom of their reſpective working barrels, in order that they alſo may make a working ſtroke. This requires force independent of the friction and inertia of the moving parts; for each piſton muſt be puſhed down through the water in the barrel, which muſt riſe through the piſton with a velocity whoſe proportion to the velocity of the piſton is the ſame with that of the bulk of the piſton to the bulk of the perforation through which the water riſes through the piſton. It is enough at preſent to mention this in general terms: we ſhall conſider it more particularly afterwards, when we come to calculate the performance of the engine, and to deduce from our acquired knowledge maxims of conſtruction and improvement.

20 The aſcent of the piſton differs greatly from the deſcent.

From this general conſideration of the aſcent of the piſton, we may ſee that the motion differs greatly from the deſcent. It can hardly be ſuppoſed to accelerate, even if the ſteam in the cylinder were in a moment annilated. For the reſiſtance to the deſcent of the piſton is the ſame with the weight of the column of water, which would cauſe it to flow through the box of the pump piſton with the velocity with which it really riſes through it, and muſt therefore increaſe as the ſquare of that velocity increaſes; that is, as the ſquare of the velocity of the piſton increaſes. Independent of friction, therefore, the velocity of deſcent through the water muſt ſoon become a maximum, and the motion become uniform. We ſhall ſee by and by, that in ſuch a pump as is generally uſed this will happen in leſs than the 10th part of a ſecond. The friction of the pump will diminiſh this velocity a little, and retard the time of its attaining uniformity. But, on the other hand, the ſupply of ſteam which is neceſſary for this motion, being ſuſceptible of no acceleration from its previous motion, and depending entirely on the briſkneſs of the ebullition, an almoſt inſtantaneous ſtop is put to acceleration.

Accordingly, any perſon who obſerves with attention the working of a ſteam-engine, will ſee that the riſe of the piſton and deſcent of the pump-rods is extremely uniform, whereas the working ſtroke is very ſenſibly accelerated. Before quitting this part of the ſubject, and leſt it ſhould afterwards eſcape our recollection, we may obſerve, that the counter weight is different during the two motions of the pump-rods. While the machine is making a working ſtroke, it is lifting not only the column of water in the pump, but the abſolute weight of the piſtons and piſton-rods alſo: but while the pump-rods are deſcending, there is a diminution of the counter weight by the whole weight loſt by the immerſion of the rod in water. The wooden rods which are generally uſed, ſoaked in water, and joined by iron ſtraps, are heavier, and but a little heavier than water, and they are generally about one-third of the bulk of the water in the pumps.

21 The counter weight is different during the two motions of the pump-rods.

Theſe two motions complete the period of the operation; and the whole may be repeated by ſhutting the ſteam-cock and opening the injection-cock whenever the piſton has attained the proper height. We have been very minute in our attention to the different circumſtances, that the reader may have a diſtinct notion of the ſtate of the moving forces in every period of the operation. It is by no means ſufficient that we know in general that the injection of cold water makes a void which allows the air to preſs down the piſton, and that the readmiſſion of the ſteam allows the piſton to riſe again. This lumping and ſlovenly way of viewing it has long prevented even the philoſopher from ſeeing the defects of the conſtruction, and the methods of removing them.

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22 Difference between Savary's and Newcomen's machines.

We now ſee the great difference between Savary's and Newcomen's engine in reſpect of principle. Savary's was really an engine which raiſed water by the force of ſteam; but Newcomen's raiſes water entirely by the preſſure of the atmoſphere, and ſteam is employed merely as the moſt expeditious method of producing a void, into which the atmoſpherical preſſure may impel the *firſt mover* of his machine. The elaſticity of the ſteam is not the firſt mover.

23 Superiority of Newcomen's.

We ſee alſo the great ſuperiority of this new machine. We have no need of ſteam of great and dangerous elaſticity; and we operate by means of very moderate heats, and conſequently with much ſmaller quantities of fuel; and there is no bounds to the power of this machine. How deep ſoever a mine may be, a cylinder may be employed of ſuch dimenſions that the preſſure of the air on its piſton may exceed in any degree the weight of the column of water to be raiſed. And laſtly, this form of the machine renders it applicable to almoſt every mechanical purpoſe; becauſe a ſkilful mechanic can readily find a method of converting the reciprocating motion of the working beam into a motion of any kind which may ſuit his purpoſe. Savary's engine could hardly admit of ſuch an immediate application, and ſeems almoſt reſtricted to raiſing water.

24 Gradually improved

Inventions improve by degrees. This engine was firſt offered to the public in 1705. But many difficulties occurred in the execution, which were removed one by one; and it was not till 1712 that the engine ſeemed to give confidence in its efficacy. The moſt exact and unremitting attention of the manager was required to the preciſe moment of opening and ſhutting the cocks; and neglect might frequently be ruinous, by beating out the bottom of the cylinder, or allowing the piſton to be wholly drawn out of it. Stops were contrived to prevent both of theſe accidents; then ſtrings were uſed to connect the handles of the cocks with the beam, ſo that they ſhould be turned whenever it was in certain poſitions. Theſe were gradually changed and improved into detents and catches of different ſhapes; at laſt, in 1717, Mr Beighton, a very ingenious and well informed artiſt, ſimplified the whole of theſe ſubordinate movements, and brought the machine into the form in which it has continued, without the ſmalleſt material change, to the preſent day. We ſhall now deſcribe one of theſe improved engines, copying almoſt exactly the drawings and deſcription given by Boſſut in his *Hydrodynamique*; theſe being by far the moſt accurate and perſpicuous of any that have been publiſhed.

25 And ſimplified.

Plate CCCCLXXVIII

Fig. 8. n° 1. is a perſpective view of the boiler cylinder, and all the parts neceſſary for turning the cocks. Fig. 8. n° 2. is a vertical ſection of the ſame; and the ſame pieces of both are marked with the ſame letters of reference.

The

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16 Deſcription of Beighton's ſteam-engine.

The rod X of the piſton P is ſuſpended from the arch of the working-beam, as was repreſented in the preceding ſketch (fig. 7). An upright bar of timber FG is alſo ſeen hanging by a chain. This is ſuſpended from a concentric arch of the beam, as may be ſeen alſo in the ſketch at $\varphi \delta$. This bar is called the *plug-beam*, and it muſt riſe and fall with the piſton, but with a ſlower motion. The uſe of this plug-beam is to give motion to the different pieces which turn the cocks.

The ſteam-pipe K is of one piece with the bottom of the cylinder, and riſes within it an inch or two, to prevent any of the cold injection water from falling into the boiler. The lower extremity Z of the ſteam-pipe penetrates the head of the boiler, projecting a little way. A flat plate of braſs, in ſhape reſembling a racket or battledore, called the *regulator*, applies itſelf exactly to the whole circumference of the ſteam-pipe, and completely excludes the ſteam from the cylinder. Being moveable round an upright axis, which is repreſented by the dotted lines at the ſide of the ſteam-pipe in the profile, it may be turned aſide by the handle *i*, n° 1. The profile ſhows in the ſection of this plate a protuberance in the middle This reſts on a ſtrong flat ſpring, which is fixed below it athwart the mouth of the ſteam-pipe. This ſpring preſſes it ſtrongly towards the ſteam-pipe, cauſing it to apply very cloſe; and this knob ſlides along the ſpring, while the regulator turns to the right or left.

We have ſaid that the injection water is furniſhed from a ciſtern placed above the cylinder. When this ciſtern cannot be ſupplied by pipes from ſome more elevated ſource, its water is raiſed by the machine itſelf. A ſmall lifting pump *i k* (fig. 7.), called the *jack-head* or *jacquette*, is worked by a rod $\gamma \iota$, ſuſpended from a concentric arch $\iota \gamma$ near the outer end of the working beam. This forces a ſmall portion of the pit water along the riſing pipe *i* LM into the injection ciſtern.

In figure 8. n° 1. and 2. the letters QM 3′ repreſent the pipe which brings down the water from the injection ciſtern. This pipe has a cock at R to open or ſhut the paſſage of this water. It ſpouts through the jet 3′, and daſhing againſt the bottom of the piſton, it is diſperſed into drops, and ſcattered through the whole capacity of the cylinder, ſo as to produce a rapid condenſation of the ſteam.

An upright poſt A may be obſerved in the perſpective view of the cylinder, &c. This ſupports one end B of a horizontal iron axis BC. The end C is ſupported by a ſimilar poſt, of which the place only is marked by the dotted lines A, that the pieces connected with this axis may not be hid by it. A kind of ſtirrup *a b c d* hangs from this axis, ſupported by the hooks *a* and *d*. This ſtirrup is croſſed near the bottom by a round bolt or bar *e*, which paſſes through the eyes or rings that are at the ends of the horizontal fork *h f g*, whoſe long tail *b* is double, receiving between its branches the handle *i* of the regulator. It is plain from this conſtruction, that when the ſtirrup is made to vibrate round the horizontal axis BC, on which it hangs freely by its hooks, the bolt *e* muſt pull or puſh the long fork *h f g* backwarks and forwards horizontally, and by ſo doing will move the regulator round its axis by means of the handle *i*. Both the tail of the fork and the handle of the regulator are pierced with ſeveral holes, and a pin is put through them which unites them by a joint. The motion of the handle may be increaſed or diminiſhed by chooſing for the joint a hole near to the axis or remote from it; and the exact poſition at which the regulator is to ſtop on both ſides is determined by pins ſtuck in the horizontal bar on which the end of the handle appears to reſt.

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This alternate motion of the regulator to the right and left is produced as follows: There is fixed to the axis BC a piece of iron *o k l*, called the Y, on account of its reſemblance to that letter of the alphabet inverted. The ſtalk *o* carries a heavy lump *p* of lead or iron; and a long leather ſtrap *q p r* is faſtened to *p* by the middle, and the two ends are faſtened to the beam above it, in ſuch a manner that the lump may be alternately catched and held up to the right and left of the perpendicular. By adjuſting the length of the two parts of the ſtrap, the Y may be ſtopped in any deſired poſition. The two claws *k* and *l* ſpread out from each other, and from the line of the ſtalk, and they are of ſuch length as to reach the horizontal bolt *e*, which croſſes the ſtirrup below, but not to reach the bottom of the fork *h f g*. Now ſuppoſe the ſtirrup hanging perpendicularly, and the ſtalk of the Y alſo held perpendicular; carry it a little outward from the cylinder, and then let it go. It will tumble farther out by its weight, without affecting the ſtirrup till the claw *l* ſtrikes on the horizontal bolt *e*, and then it puſhes the ſtirrup and the fork towards the cylinder, and opens the regulator. It ſets it in motion with a ſmart jerk, which is an effectual way of overcoming the cohefion and friction of the regulator with the mouth of the ſteam-pipe. This puſh is adjuſted to a proper length by the ſtrap *q p*, which ſtops the Y when it has gone far enough. If we now take hold of the ſtalk of the Y, and move it up to the perpendicular, the width between its claws is ſuch as to permit this motion, and ſomething more, without affecting the ſtirrup. But when puſhed ſtill nearer to the cylinder, it tumbles towards it by its own weight, and then the claw *k* ſtrikes the bolt *e*, and drives the ſtirrup and fork in the oppoſite direction, till the lump *p* is catched by the ſtrap *r p*, now ſtretched to its full length, while *q p* hangs ſlack. Thus by the motion of the Y the regulator is opened and ſhut. Let us now ſee how the motion of the Y is produced by the machine itſelf. To the horizontal axis BC are attached two ſpanners or handles *m* and *n*. The ſpanner *m* paſſes through a long ſlit in the plug-beam, and is at liberty to move upwards or downwards by its motion round the axis BC. A pin *π* which goes through the plug-beam catches hold of *m* when the beam riſes along with the piſton; and the pin is ſo placed, that when the beam is within an inch or two of its higheſt riſe, the pin has lifted *m* and thrown the ſtalk of the Y paſt the perpendicular. It therefore tumbles over with great force, and gives a ſmart blow to the fork, and immediately ſhuts the regulator. By this motion the ſpanner *m* is removed out of the neighbourhood of the plug-beam. But the ſpanner *n*, moving along with it in the ſame direction, now comes into the way of the pins of the plug-beam. Therefore, when the piſton deſcends again by the condenſation of the ſteam in the cylinder, a pin marked & in the ſide of the plug-beam catches hold of the tail of the ſpanner *n*, and by preſſing it down raiſes the lump on the

ſtalk

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ſtalk of the Y till it paſſes the perpendicular, and it then falls down, outwards from the cylinder, and the claw *l* again drives the fork in the direction *h i*, and opens the ſteam valve. This opening and ſhutting of the ſteam valve is executed in the preciſe moment that is proper, by placing the pins ϰ and & at a proper height in the plug-beam. For this reaſon, it is pierced through with a great number of holes, that the places of theſe pins may be varied at pleaſure. This, and a proper curvature of the ſpanners *m* and *n*, make the adjuſtment as nice as we pleaſe.

The injection-cock R is managed in a ſimilar manner. On its key may be obſerved a forked arm *s t*, like a crab's claw; at a little diſtance above it is the gudgeon or axis *u* of a piece *y u z*, called the hammer or the F, from its reſemblance to that letter. It has a lump of metal *y* at one end, and a ſpear *u s* projects from its middle, and paſſes between the claws *s* and *t* of the arm of the injection-cock. The hammer *y* is held up by a notch in the underſide of a wooden lever DE, moveable round the centre D, and ſupported at a proper height by a ſtring *r* E made faſt to the joiſt above it.

Suppoſe the injection-cock ſhut, and the hammer in the poſition repreſented in the figure. A pin *ß* of the plug-frame riſes along with the piſton, and catching hold of the detent DE, raiſes it, and diſengages the hammer *y* from its notch. This immediately falls down, and ſtrikes a board L put in the way to ſtop it. The ſpear *u s* takes hold of the claw *t*, and forces it aſide towards *x*, and opens the injection-cock. The piſton immediately deſcends, and along with it the plug-frame. During its deſcent the pin *ß* meets with the tail *u z* of the hammer, which is now raiſed conſiderably above the level, and brings it down along with it, raiſing the lump *y*, and gradually ſhutting the injection-cock, becauſe the ſpear takes hold of the claw *s* of its arm. When the beam has come to its loweſt ſituation, the hammer is again engaged in the notch of the detent DE, and ſupported by it till the piſton again reaches the top of the cylinder.

In this manner the motions of the injection-cock are alſo adjuſted to the preciſe moment that is proper for them. The different pins are ſo placed in the plug-frame, that the ſteam-cock may be completely ſhut before the injection-cock is opened. The inherent motion of the machine will give a ſmall addition to the aſcent of the piſton without expending ſteam all the while; and by leaving the ſteam rather leſs elaſtic than before, the ſubſequent deſcent of the piſton is promoted. There is a conſiderable propriety in the gradual ſhutting of the injection-cock. For after the firſt daſh of the cold water againſt the bottom of the piſton, the condenſation is nearly complete, and very little more water is needed; but a continual acceſſion of ſome is abſolutely neceſſary for completing the condenſation, as the capacity of the cylinder diminiſhes, and the water warms which is already injected.

In this manner the motion of the machine will be repeated as long as there is a ſupply of ſteam from the boiler, and of water from the injection ciſtern, and a diſcharge procured for what has been injected. We proceed to conſider how theſe conditions alſo are provided by the machine itſelf.

The injection ciſtern is ſupplied with water by the jackhead-pump, as we have already obſerved. From this ſource all the parts of the machine receive their reſpective ſupplies. In the firſt place, a ſmall branch 13, 13, is taken off from the injection-pipe immediately below the ciſtern, and conducted to the top of the cylinder, where it is furniſhed with a cock. The ſpout is ſo adjuſted, that no more runs from it than what will keep a conſtant ſupply of a foot of water above the piſton to keep it tight. Every time the piſton comes to the top of the cylinder, it brings this water along with it, and the ſurplus of its evaporation and leakage runs off by a waſte pipe 14, 14. This water neceſſarily becomes almoſt boiling hot, and it was thought proper to employ its overplus for ſupplying the waſte of the boiler. This was accordingly practiſed for ſome time. But Mr Beighton improved this economical thought, by ſupplying the boiler from the eduction-pipe 2, 2, the water of which muſt be ſtill hotter than that above the piſton. This contrivance required attention to many circumſtances, which the reader will underſtand by conſidering the perſpective and profile. The eduction pipe comes out of the bottom of the cylinder at 1 with a perpendicular part, which bends ſidewiſe below, and is ſhut at the extremity 1. A deep cup 5 communicates with it, holding a metal valve nicely fitted to it by grinding, like the key of a cock. To ſecure its being always air-tight, a ſlender ſtream of water trickles into it from a branch 6 of the waſte pipe from the top of the cylinder. The eduction-pipe branches off at 2, and goes down to the hot well, where it turns up, and is covered with a valve. In the perſpective view may be obſerved an upright pipe 4, 4, which goes through the head of the boiler, and reaches to within a few inches of its bottom. This pipe is called the *feeder*, and riſes about three or four feet above the boiler. It is open at both ends, and has a branch 3, 3, communicating with the bottom of the cup 5, immediately above the metal valve, and alſo a few inches below the level of the entry 2 of the eduction-pipe. This communicating branch has a cock by which its paſſage may be diminiſhed at pleaſure. Now ſuppoſe the ſteam in the boiler to be very ſtrong; it will cauſe the boiling water to riſe in the feeding pipe above 3, and coming along this branch, to riſe alſo in the cup 5, and run over. But the height of this cup above the ſurface of the water in the boiler is ſuch, that the ſteam is never ſtrong enough to produce this effect. Therefore, on the contrary, any water that may be in the cup 5 will run off by the branch 3, 3, and go down into the boiler by the feeding pipe.

27 An ingenious contrivance.

Theſe things being underſtood, let us ſuppoſe a quantity of injected water lying at the bottom of the cylinder. It will run into the eduction-pipe, fill the crooked branch 1, 1, and open the valve in the bottom of the cup (its weight being ſupported by a wire hanging from a ſlender ſpring), and it will fill the cup to the level of the entry 2 of the eduction-pipe, and will then flow along 3, 3, and ſupply the boiler by the feeder 4, 4. What more water runs in at 1 will now go along the eduction-pipe 2, 2, to the hot well. By properly adjuſting the cock on the branch 3,3, the boiler may be ſupplied as faſt as the waſte in ſteam requires. This is a moſt ingenious contrivance, and does great honour to Mr Beighton. It is not, however, of much importance. The ſmall quantity which the boiler requires

may

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may be immediately taken even from a cold ciſtern, without ſenſibly diminiſhing the production of ſteam: for the quantity of heat neceſſary for raiſing the ſenſible heat of cold water to the boiling temperature is quite inſignificant, when compared with the quantity of heat which muſt then be combined with it in order to convert the water into ſteam. No difference can be obſerved in the performance of ſuch engines and of thoſe which have their boilers ſupplied from a brook. It has, however, the advantage of being purged of air; and when an engine muſt derive all its ſupplies from pit water, the water from the eduction-pipe is vaſtly preferable to that from the top of the cylinder.

We may here obſerve, that many writers (among them the Abbé Boſſut), in their deſcriptions of the ſteam-engine, have drawn the branch of communication 3, 3, from the feeding pipe to a part of the crooked pipe 1, 1, lying below the valve in the cup 5. But this is quite erroneous; for, in this caſe, when the injection is made into the cylinder, and a vacuum produced, the water from the boiler would immediately ruſh up through the pipes 4, 3, and ſpout up into the cylinder: ſo would the external air coming in at the top of the feeder.

28 Which enables us to form ſome judgment of the internal ſtate of the engine during the performance.

This contrivance has alſo enabled us to form ſome judgment of the internal ſtate of the engine during the performance. Mr Beighton paid a minute attention to the ſituation of the water in the feeders and eduction-pipe of an engine, which ſeems to have been one of the beſt which has yet been erected. It was lifting a column of water whoſe weight was $\frac{4}{7}$ths of the preſſure of the air on its piſton, and made 16 ſtrokes, of 6 feet each, in a minute. This is acknowledged by all to be a very great performance of an engine of this form. He concluded that the elaſticity of the ſteam in the cylinder was never more than one-tenth greater or leſs than the elaſticity of the air. The water in the feeder never roſe more than three feet and a half above the ſurface of the boiling water, even though it was now lighter by $\frac{1}{17}$th than cold water. The eduction-pipe was only $4\frac{1}{2}$ feet long (vertically), and yet it always diſcharged the injection water completely, and allowed ſome to paſs into the feeder. This could not be if the ſteam was much more than $\frac{1}{10}$th weaker than air. By graſping this pipe in his hand during the riſe of the piſton, he could gueſs very well whereabouts the ſurface of the hot water in it reſted during the motion, and he never found it ſupported ſo high as four feet. Therefore the ſteam in the cylinder had at leaſt $\frac{8}{9}$ths of the elaſticity of the air. Mr Buat, in his examination of an engine which is erected at Montrelaix, in France, by an Engliſh engineer, and has always been conſidered as the pattern in that country, finds it neceſſary to ſuppoſe a much greater variation in the ſtrength of the ſteam, and ſays that it muſt have been $\frac{1}{3}$th ſtronger and $\frac{1}{3}$th weaker than common air. But this engine has not been nearly ſo perfect. Its liſt was not more than $\frac{1}{3}$ of the preſſure of the atmoſphere, and it made but nine ſtrokes in a minute.—At W is a valve covering the mouth of a ſmall pipe, and ſurrounded with a cup containing water to keep it air-tight. This allows the air to eſcape which had been extricated from the water of laſt injection. It is driven out by the firſt ſtrong puff of ſteam which is admitted into the cylinder, and makes a noiſe in its exit. This valve is therefore called the ſnifting valve.

To finiſh our deſcription, we obſerve, that beſides the ſafety valve 9 (called the PUPPET CLACK), which is loaded with about 3 pounds on the ſquare inch (though the engine will work very well with a load of 1 or 2 pounds), there is another DISCHARGER 10, 10, having a clack at its extremity ſupported by a cord. Its uſe is to diſcharge the ſteam without doors, when the machine gives over working. There is alſo a pipe S I near the bottom of the boiler, by which it may be emptied when it needs repairs or cleanſing.

There are two ſmall pipes 11, 11, and 12, 12, with cocks called GAGE-PIPES. The firſt deſcends to within two inches of the ſurface of the water in the boiler, and the ſecond goes about 2 inches below that ſurface. If both cocks emit ſteam, the water is too low, and requires a recruit. If neither give ſteam, it is too high, and there is not ſufficient room above it for a collection of ſteam. Laſtly, there is a filling pipe Q, by which the boiler may be filled when the machine is to be ſet to work.

29 This form of the engine has been continued for many years, the only change being the poſition of the boiler.

The engine has continued in this form for many years. The only remarkable change introduced has been the manner of placing the boiler. It is no longer placed below the cylinder, but at one ſide, and the ſteam is introduced by a pipe from the top of the boiler into a flat box immediately below the cylinder. The uſe of this box is merely to lodge the regulator, and give room for its motions. This has been a very conſiderable improvement. It has greatly reduced the height of the building. This was formerly a tower. The wall which ſupported the beam could hardly be built with ſufficient ſtrength for withſtanding the violent ſhocks which were repeated without ceaſing; and the buildings ſeldom laſted more than a very few years. But the boiler is now ſet up in an adjoining ſhed, and the gudgeons of the main beam reſt on the top of upright poſts, which are framed into the joiſts which ſupport the cylinder. Thus the whole moving parts of the machine are contained in one compact frame of carpentry, and have little or no connection with the ſlight walls of the building, which is merely a caſe to hold the machine, and protect it from the weather.

30 How to aſcertain the moſt advantageous proportion between the moving power and the load.

It is now time to inquire what is to be expected from this machine, and to aſcertain the moſt advantageous proportion between the moving power and the load that is to be laid on the machine.

It may be conſidered as a great pulley, and is indeed ſometimes ſo conſtructed, the arches at the ends of the working beam being completed to a circle. It muſt be unequally loaded that it may move. It is loaded, during the working ſtroke, by the preſſure of the atmoſphere on the piſton ſide, and by the column of water to be raiſed and the pump-gear on the pump ſide.—During the returning ſtroke it is loaded, on the piſton ſide, by a ſmall part of the atmoſpheric preſſure, and on the pump ſide by the pump gear acting as a counter weight. The load during the working ſtroke muſt therefore conſiſt of the column of water to be raiſed and this counter weight. The performance of the machine is to be meaſured only by the quantity of water raiſed in a given time to a given height. It varies, therefore, in the joint proportion of the weight of the column of water in the pumps, and the number of ſtrokes made by the machine in a minute. Each ſtroke conſiſts of two parts, which we have called the working and the returning ſtroke. It does not, therefore, depend ſimply on the velocity of the working ſtroke and the

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quantity of water raiſed by it. If this were all that is to be attended to, we know that the weight of the column of water ſhould be nearly $\frac{2}{7}$ths of the preſſure of the atmoſphere, this being the proportion which gives the maximum in the common pulley. But the time of the returning ſtroke is a neceſſary part of the whole time elapſed, and therefore the velocity of the returning ſtroke equally merits attention. This is regulated by the counter weight. The number of ſtrokes *per* minute does not give an immediate proof of the goodneſs of the engine. A ſmall load of water and a great counter weight will enſure this, becauſe theſe conditions will produce a briſk motion in both directions.—The proper adjuſtment of the preſſure of the atmoſphere on the piſton, the column of water to be raiſed, and the counter weight, is a problem of very great difficulty; and mathematicians have not turned much of their attention to the ſubject, although it is certainly the moſt intereſting queſtion that practical mechanics affords them.

31 Mr Boſſut's ſolution,

Mr Boſſut has ſolved it very ſhortly and ſimply, upon this ſuppoſition, that the working and returning ſtroke ſhould be made in equal times. This, indeed, is generally aimed at in the erection of theſe machines, and they are not reckoned to be well arranged if it be otherwiſe. We doubt of the propriety of the maxim. Suppoſing, however, this condition for the preſent, we may compute the loadings of the two ends of the beam as follows. Let a be the length of the inner arm of the working beam, or that by which the great piſton is ſupported. Let b be the outer arm carrying the pump rods, and let W be a weight equivalent to all the load which is laid on the machine. Let c^2 be the area of the piſton; let H be the height of a column of water having c^2 for its baſe, and being equal in weight to the preſſure exerted by the ſteam on the under ſide of the piſton; and let b be the preſſure of the atmoſphere on the ſame area, or the height of a column of water of equal weight. It is evident that both ſtrokes will be performed in equal times, if $b c^2 a - W b$ be equal to $(b - H) c^2 a + W b$. The firſt of theſe quantities is the energy of the machine during the working ſtroke, and the ſecond expreſſes the ſimilar energy during the returning ſtroke. This equation gives us $W = \frac{2 b c^2 a - H c^2 a}{2 b} = \frac{(2 b - H) c^2 a}{2 b}$. If we ſuppoſe the arms of the lever equal and $H = b$, we have $W = c^2 \frac{b}{2}$; that is, the whole weight of the outer end of the beam ſhould be half the preſſure of the air on the great piſton. This is nearly the uſual practice; and the engineers expreſs it by ſaying, that the engine is loaded with ſeven or eight pounds on the ſquare inch.

32 Founded on an erroneous maxim

This has been found to be nearly the moſt advantageous load. This way of expreſſing the matter would do well enough, if the maxim were not founded on erroneous notions, which hinder us from ſeeing the ſtate of the machine, and the circumſtances on which its improvement depends. The piſton bears a preſſure of 15 pounds, it is ſaid, on the ſquare inch, if the vacuum below it be perfect; but as this is far from being the caſe, we muſt not load it above the power of its vacuum, which very little exceeds eight pounds. But this is very far from the truth. When the cylinder is tight, the vacuum is not more than $\frac{1}{10}$th deficient, when the cylinder is cooled by the injection to the degree that is every day practicable, and the piſton really bears during its deſcent a preſſure very near to 14 pounds on the inch. The load muſt be diminiſhed, not on account of the imperfect vacuum, but to give the machine a reaſonable motion. We muſt conſider not only the moving force, but alſo the quantity of matter to be put in motion. This is ſo great in the ſteam-engine, that even if it were balanced, that is, if there were ſuſpended on the piſton arm a weight equal to the whole column of water and the counter weight, the full preſſure of the atmoſphere on the ſteam piſton would not make it move twice as faſt as it does.

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33 And faulty in another reſpect.

This equation by Mr Boſſut is moreover eſſentially faulty in another reſpect. The W in the firſt member is not the ſame with the W in the ſecond. In the firſt it is the column of water to be raiſed, together with the counter weight. In the ſecond it is the counter weight only. Nor is the quantity H the ſame in both caſes, as is moſt evident. The proper equation for enſuring the equal duration of the two ſtrokes may be had in the following manner. Let it be determined by experiment what portion of the atmoſpheric preſſure is exerted on the great piſton during its deſcent. This depends on the remaining elaſticity of the ſteam. Suppoſe it $\frac{9}{10}$ths: this we may expreſs by $a h$, a being $= \frac{9}{10}$ths. Let it alſo be determined by experiment what portion of the atmoſpheric preſſure on the piſton remains unbalanced by the ſteam below it during its aſcent. Suppoſe this $\frac{1}{10}$th, we may expreſs this by $b h$. Then let W be the weight of the column of water to be raiſed, and c the counter weight. Then, if the arms of the beam are equal, we have the energy during the working ſtroke $= a h - W - c$, and during the returning ſtroke it is $= c - b h$. Therefore $c - b h = a h - W - c$; and $c = \frac{h (a + b) - W}{2}$; which, on the above ſuppoſition of the values of a and b, gives us $c = \frac{h - W}{2}$. We ſhall make ſome uſe of this equation afterwards; but it affords us no information concerning the moſt advantageous proportion of h and W, which is the material point.

34 Another way of conſidering the matter.

We muſt conſider this matter in another way: And that we may not involve ourſelves in unneceſſary difficulties, let us make the caſe as ſimple as poſſible, and ſuppoſe the arms of the working-beam to be of equal length.

We ſhall firſt conſider the adjuſtment of things at the outer end of the beam.

35 Adjuſtment of things at the outer end of the beam conſidered.

Since the ſole uſe of the ſteam is to give room for the action of the atmoſpheric preſſure by its rapid condenſibility, it is admitted into the cylinder only to allow the piſton to riſe again, but without giving it any impulſe. The pump-rods muſt therefore be returned to the bottom of the working barrels by means of a preponderancy at the outer end of the beam. It may be the weight of the pump-rods themſelves, or may be conſidered as making part of this weight. A weight at the end of the beam will not operate on the rods which are ſuſpended there by chains, and it muſt therefore be attached to the rods themſelves, but above their reſpective pump-barrels, ſo that it may not loſe part of its efficacy by immerſion in the water. We may conſider the whole under the notion of the pump-gear, and call it p. Its office is to depreſs the pump-rods with ſuffi-

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cient velocity, by overcoming the reſiſtances ariſing from the following cauſes.

1. From the inertia of the beams and all the parts of the apparatus which are in motion during the deſcent of the pump-rods.

2. From the loſs of weight ſuſtained by the immerſion of the pump-rods in water.

3. From the friction of all the piſtons and the weight of the plug-frame.

4. From the reſiſtance to the piſton's motion, ariſing from the velocity which muſt be generated in the water in paſſing through the deſcending piſtons.

The ſum of all theſe reſiſtances is equal to the preſſure of ſome weight (as yet unknown), which we may call m.

When the pump-rods are brought up again, they bring along with them a column of water, whoſe weight we may call w.

It is evident that the load which muſt be overcome by the preſſure of the atmoſphere on the ſteam piſton conſiſts of w and p. Let this load be called L, and the preſſure of the air be called P.

If p be $=$ L, no water will be raiſed; if p be $= o$, the rods will not deſcend: therefore there is ſome intermediate value of p which will produce the greateſt effect.

In order to diſcover this, let g be the fall of a heavy body in a ſecond.

The deſcending maſs is p: but it does not deſcend with its full weight; becauſe it is overcoming a ſet of reſiſtances which are equivalent to a weight m, and the moving force is $p-m$. In order to diſcover the ſpace through which the rods will deſcend in a ſecond, when urged by the force $p-m$ (ſuppoſed conſtant, notwithſtanding the increaſe of velocity, and conſequently of m), we muſt inſtitute this proportion $p : p-m = g : \frac{g(p-m)}{p}$.

The fourth term of this analogy is the ſpace required.

Let t be the whole time of the deſcent in ſeconds. Then $1^2 : t^2 = \frac{g(p-m)}{p} : \frac{t^2 g(p-m)}{p}$. This laſt term is the whole deſcent or length of the ſtroke accompliſhed in the time t.

The weight of the column of water, which has now got above the piſton, is w, $=$ L $- p$. This muſt be lifted in the next working ſtroke through the ſpace $\frac{t^2 g(p-m)}{p}$. Therefore the performance of the engine muſt be $\frac{t^2 g(p-m)(L-p)}{p}$.

That this may be the greateſt poſſible, we muſt conſider p as the variable quantity, and make the fluxion of the fraction $\frac{\overline{p-m} \times \overline{L-p}}{p} = o$.

This will be found to give us $p = \sqrt{Lm}$; that is, the counter weight or preponderancy of the outer end of the beam is $= \sqrt{Lm}$.

This gives us a method of determining m experimentally. We can diſcover by actual meaſurement the quantity L in any engine, it being equal to the unbalanced weights on the beam and the weight of the water in the pumps. Then $m = \frac{p^2}{L}$.

Alſo we have the weight of the column of water $= L - p$, $= L - \sqrt{Lm}$.

When therefore we have determined the load which is to be on the outer end of the beam during the working ſtroke, it muſt be diſtributed into two parts, which have the proportion of $\sqrt{Lm}$ to $L - \sqrt{Lm}$. The firſt is the counter weight, and the ſecond is the weight of the column of water.

If m is a fraction of L, ſuch as an aliquot part of it; that is, if

$$m = \frac{L}{1}, \frac{L}{4}, \frac{L}{9}, \frac{L}{16}, \frac{L}{25}, \text{ \&c.}$$
$$p = \frac{L}{1}, \frac{L}{2}, \frac{L}{3}, \frac{L}{4}, \frac{L}{5}, \text{ \&c.}$$

The circumſtance which is commonly obtruded on us by local conſiderations is the quantity of water, and the depth from which it is to be raiſed; that is, w: and it will be convenient to determine every thing in conformity to this.

We ſaw that $w = L - \sqrt{Lm}$. This gives us $L = \pm\sqrt{wm + \frac{m^2}{4}} + \frac{m}{2} + w$, and the counter weight $p = \sqrt{wm + \frac{m^2}{4}} + \frac{m}{2}$.

36 What proportion of moving force may be applied to the greateſt advantage

Having thus aſcertained that diſtribution of the load on the outer end of the beam which produces the greateſt effect, we come now to conſider what proportion of moving force we muſt apply, ſo that it may be employed to the beſt advantage, or ſo that any expence of power may produce the greateſt performance. It will be ſo much the greater as the work done is greater, and the power employed is leſs; and will therefore be properly meaſured by the quotient of the work done divided by the power employed.

The work immediately done is the lifting up the weight L. In order to accompliſh this, we muſt employ a preſſure P, which is greater than L. Let it be $= L + y$; alſo let s be the length of the ſtroke.

If the maſs L were urged along the ſpace s by the force $L+y$, it would acquire a certain velocity, which we may expreſs by $\sqrt{s}$; but it is impelled only by the force y, the reſt of P being employed in balancing L. The velocities which different forces generate by impelling a body along the ſame ſpace are as the ſquare roots of the forces. Therefore $\sqrt{L+y} : \sqrt{y} = \sqrt{s} : \frac{\sqrt{sy}}{\sqrt{L+y}}$. The fourth term of this analogy expreſſes the velocity of the piſton at the end of the ſtroke. The quantity of motion produced will be had by multiplying this velocity by the maſs L. This gives $\frac{L \times \sqrt{sy}}{\sqrt{L+y}}$; and this, divided by the power expended, or by $L+y$, gives us the meaſure of the performance; namely, $\frac{L\sqrt{sy}}{L+y \times \sqrt{L+y}}$.

That this may be a maximum, conſider y as the variable

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riable quantity, and make the fluxion of this formula $= o$. This will give us $y = \frac{L}{2}$.

Now $P = L + y$, $= L + \frac{L}{2}$, $= \frac{3}{2} L$. Therefore the *whole* load on the outer end of the beam, conſiſting of the water and the counter weight, muſt be $\frac{2}{3}$ds of the preſſure of the atmoſphere on the ſteam piſton.

We have here ſuppoſed that the expenditure is the atmoſpheric preſſure; and ſo it is if we conſider it mechanically. But the expenditure of which we are ſenſible, and which we are anxious to employ to the beſt advantage, is fuel. Suppoſing this to be employed with the ſame judgment in all caſes, we are almoſt intitled, by what we now know of the production of ſteam, to ſay that the ſteam produced is proportional to the fuel expended. But the ſteam requiſite for merely filling the cylinder is proportional to the area of the piſton, and therefore to the atmoſpheric preſſure. The reſult of our inveſtigation therefore is ſtill juſt; but the ſteam waſted by condenſation on the ſides of the cylinder does not follow this ratio, and this is more than what is neceſſary for merely filling it. This deranges our calculations, and is in favour of large cylinders; but this advantage muſt be in a great meaſure compenſated by a ſimilar variation in the production of the ſteam; for in ſimilar boilers of greater dimenſions the fuel is leſs advantageouſly employed, becauſe the ſurface to which the fuel is applied does not increaſe in the ratio of the capacity, juſt as the ſurface of the cylinder which waſtes the ſteam. The rule may therefore be conſided in as pretty exact.

37 Theſe reſults agree with the moſt ſucceſsful practice.

It is a ſatisfactory thing to obſerve theſe reſults agree very well with the moſt ſucceſsful practice. By many changes and trials engineers have eſtabliſhed maxims of conſtruction, which are probably not very far from the beſt. It is a pretty general maxim, that the load of water ſhould be $\frac{1}{7}$ of the atmoſpheric preſſure. They call this loading the engine with $7\frac{1}{2}$ pounds on the inch, and they ſay that ſo ſmall a load is neceſſary on account of the imperfect vacuum. But we have now ſeen that it is neceſſary for giving a reaſonable velocity of motion. Since, in this practice, w is ma e $\frac{1}{7}$ or $\frac{6}{12}$ths of P, and L ſhould be $\frac{8}{12}$ths of P, and L is $= w + p$; it follows, that the counter weight ſhould be $\frac{1}{6}$th of P; and we have found this to be nearly the caſe in ſeveral very good engines.

It muſt be remarked, that in the preceding inveſtigation we introduced a quantity M to expreſs the reſiſtances to the motion of the engine. This was done in order to avoid a very troubleſome inveſtigation. The reſiſtances are of ſuch a nature as to vary with the velocity, and moſt of them as the ſquare of the velocity. This is the caſe with the reſiſtance ariſing from the motion of the water through the piſtons of the pumps, and that ariſing from the friction in the long liſt during the working ſtroke. Had we taken the direct method, which is ſimilar to the determination of the motion thro' a medium which reſiſts in the duplicate ratio of the velocity, we muſt have uſed a very intricate exponential calculus, which few of our readers would have the patience to look at.

But the greateſt part of the quantity m ſuppoſes a motion already known, and its determination depends on this motion. We muſt now ſhow how its different component parts may be computed. Steam-Engine.

38 Reſiſtance to the motion of the engine computed.

1. What ariſes from the inertia of the moving parts is by far the moſt conſiderable portion of it. To obtain it, we muſt find a quantity of matter which, when placed at the end of the beam, will have the ſame momentum of inertia with that of the whole moving parts in their natural places. Therefore (in the returning ſtroke) add together the weight of the great piſton with its rod and chains; the pit pump-rods, chains, and any weight that is attached to them; the arch-heads and iron-work at the ends of the beam, and $\frac{4}{9}$ths of the weight of the beam itſelf; alſo the plug-beam with its arch-head and chain, multiplied by the ſquare of its diſtance from the axis, and divided by the ſquare of half the length of the beam; alſo the jack-head pump-rod, chain, and arch-head, multiplied by the ſquare of its diſtance from the axis, and divided by the ſquare of the half-length of the beam. Theſe articles added into one ſum may be called M, and may be ſuppoſed to move with the velocity of the end of the beam. Suppoſe this beam to have made a ſix-foot ſtroke in two ſeconds, with an uniformly accelerated motion. In one ſecond it would have moved $1\frac{1}{2}$ feet, and would have acquired the velocity of three feet per ſecond. But in one ſecond gravity would have produced a velocity of 32 feet in the ſame maſs. Therefore the accelerating force which has produced the velocity of three feet is nearly $\frac{1}{11}$th of the weight. Therefore $\frac{M}{11}$ is the firſt conſtituent of m in the above inveſtigation. If the obſerved velocity is greater or leſs than three feet per ſecond, this value muſt be increaſed or diminiſhed in the ſame proportion.

The ſecond cauſe of reſiſtance, viz. the immerſion of the pump-rods in water, is eaſily computed, being the weight of the water which they diſplace.

The third cauſe, the friction of the piſtons, &c. is almoſt inſignificant, and muſt be diſcovered by experiment.

The fourth cauſe depends on the ſtructure of the pumps. Theſe pumps, when made of a proper ſtrength, can hardly have the perforation of the piſton more than a fourth part of the area of the working barrel; and the velocity with which the water paſſes through it is increaſed at leaſt $\frac{1}{4}$th by the contraction (ſee PUMP). The velocity of the water is therefore five times greater than that of the piſton. A piſton 12 inches diameter, and moving one foot per ſecond, meets with a reſiſtance equal to 20 pounds; and this increaſes as the ſquare of the diameter and as the ſquare of the velocity. If the whole depth of the pit be divided into ſeveral lifts, this reſiſtance muſt be multiplied by the number of lifts, becauſe it obtains in each pump.

Thus we make up the value of m; and we muſt acknowledge that the method is ſtill indirect, becauſe it ſuppoſes the velocity to be known.

We may obtain it more eaſily in another way, but ſtill with this circumſtance of being indirect. We found that p was equal to $\sqrt{L\,m}$, and conſequently $m = \frac{p^2}{L}$. Now in any engine L and p can always be had; and unleſs p deviates greatly from the proportion which we determined to be the beſt, the value of m thus obtained will not be very erroneous.

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39 Obſervations concerning ſomething preſumed in the inveſtigation.

It was farther preſumed in this inveſtigation, that the motions both up and down were uniformly accelerated; but this cannot be the caſe when the reſiſtances increaſe with the velocity. This circumſtance makes very little change in the working-ſtroke, and therefore the theorem which determines the beſt relation of P to L may be confided in. The reſiſtances which vary with the velocity in this caſe are a mere trifle when compared with the moving power y. Theſe reſiſtances are, 1ſt, The ſtrangling of the water at the entry and at the ſtanding valve of each pump. This is about 37 pounds for a pump 12 inches diameter, and the velocity one foot per ſecond, increaſing in the duplicate ratio of the diameter and velocity; and, 2d, The friction of the water along the whole lift. This for a pump of the ſame ſize and with the ſame velocity, lifting 20 fathoms, is only about $2\frac{1}{7}$ pounds, and varies in the ſimple proportion of the diameter and the depth, and in the duplicate proportion of the velocity. The reſiſtance ariſing from inertia is greater than in the returning ſtroke; becauſe the M in this caſe muſt contain the momentum of the water both of the pit-pumps and the jackhead-pump: but this part of the reſiſtance does not affect the uniform acceleration. We may therefore confide in the propriety of the formula $y = \frac{L}{2}$. And we may obtain the velocity of this ſtroke at the end of a ſecond with great accuracy as follows. Let $2g$ be the velocity communicated by gravity in a ſecond, and the velocity at the end of the firſt ſecond of the ſteam piſton's deſcent will be ſomewhat leſs than $\frac{y}{M} 2g$; where M expreſſes the inertia of all the parts which are in motion during the deſcent of the ſteam piſton, and therefore includes L. Compute the two reſiſtances juſt mentioned for this velocity. Call this r. Then $\frac{y - \frac{1}{2}r}{M} 2g$ will give another velocity infinitely near the truth.

But the caſe is very different in the returning ſtroke, and the proper ratio of p to L is not aſcertained with the ſame certainty: for the moving force p is not ſo great in proportion to the reſiſtance m; and therefore the acceleration of the motion is conſiderably affected by it, and the motion itſelf is conſiderably retarded, and in a very moderate time it becomes ſenſibly uniform: for it is preciſely ſimilar to the motion of a heavy body falling through the air, and may be determined in the manner laid down in the article *Resistance of Fluids*, viz. by an exponential calculus. We ſhall content ourſelves here with ſaying, that the reſiſtances in the preſent caſe are ſo great that the motion would be to all ſenſe uniform before the piſtons have deſcended $\frac{1}{3}$d of their ſtroke, even although there were no other circumſtance to affect it.

40 The motion affected by a circumſtance that deſerves particular conſideration.

But this motion is affected by a circumſtance quite unconnected with any thing yet conſidered, depending on conditions not mechanical, and ſo uncertain, that we are not yet able to aſcertain them with any preciſion; yet they are of the utmoſt importance to the good performance and improvement of the engine, and therefore deſerve a particular conſideration.

The counter weight has not only to puſh down the pump-rods, but alſo to *drag* up the great piſton. This it cannot do unleſs the ſteam be admitted into the cylinder. If the ſteam be no ſtronger than common air, it cannot enter the cylinder except *in conſequence* of the piſton's being dragged up. If common air were admitted into the cylinder, ſome force would be required to drag up the piſton, in the ſame manner as it is required to draw up the piſton of a common ſyringe; for the air would ruſh through the ſmall entry of the cylinder in the ſame manner as through the ſmall nozzle of the ſyringe. Some part of the atmoſpheric preſſure is employed in driving in the air with ſufficient velocity to fill the ſyringe, and it is only with the remainder that the admitted air preſſes on the under ſurface of the ſyringe. Therefore ſome of the atmoſpheric preſſure on its upper ſurface is not balanced. This is felt by the hand which draws it up. The ſame thing muſt happen in the ſteam-engine, and ſome part of the counter weight is expended in drawing up the ſteam-piſton. We could tell how much is thus expended if we knew the denſity of the ſteam; for this would tell us the velocity with which its elaſticity would cauſe it to fill the cylinder. If we ſuppoſe it 12 times rarer than air, which it certainly is, and the piſton riſes to the top of the cylinder in two ſeconds, we can demonſtrate that it will enter with a velocity not leſs than 1400 feet *per* ſecond, whereas 500 feet is enough to make it maintain a denſity $\frac{9}{10}$ths of that of ſteam in equilibrio with the air. Hence it follows, that its elaſticity will not be leſs than $\frac{29}{30}$ths of the elaſticity of the air, and therefore not more than $\frac{1}{30}$th of counter weight will be expended in drawing up the ſteam-piſton.

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But all this is on the ſuppoſition that there is an unbounded ſupply of ſteam of undiminiſhed elaſticity. This is by no means the caſe. Immediately before opening the ſteam-cock, the ſteam was iſſuing through the ſafety-valve and all the crevices in the top of the boiler, and (in good engines) was about $\frac{1}{10}$th ſtronger or more elaſtic than air. This had been gathering during ſomething more than the deſcent of the piſton, viz. in about three ſeconds. The piſton riſes to the top in about two ſeconds; therefore about twice and a half as much ſteam as fills the dome of the boiler is now ſhared between the boiler and cylinder. The dome is commonly about ſix times more capacious than the cylinder. If therefore no ſteam is condenſed in the cylinder, the denſity of the ſteam, when the piſton has reached the top, muſt be about $\frac{15}{18}$ths of its former denſity, and ſtill more elaſtic than air. But as much ſteam is condenſed by the cold cylinder, its elaſticity muſt be leſs than this. We cannot tell how much leſs, both becauſe we do not know how much is thus condenſed, and becauſe by this diminution of its preſſure on the ſurface of the boiling water, it muſt be more copiouſly produced in the boiler; but an attentive obſervation of the engine will give us ſome information. The moment the ſteam-cock is opened we have a ſtrong puff of ſteam through the ſnifting valve. At this time, therefore, it is ſtill more elaſtic than air; but after this, the ſnifting valve remains ſhut during the whole riſe of the piſton, and no ſteam any longer iſſues through the ſafety-valve or crevices; nay, the whole dome of the boiler may be obſerved to ſink.

41 The elaſticity of the ſteam during the aſcent of the piſton greatly diminiſhed.

Theſe facts give abundant proof that the elaſticity of the ſteam during the aſcent of the piſton is greatly diminiſhed, and therefore much of the counter weight is expended in dragging up the ſteam-piſton in oppoſition to the unbalanced part of the atmoſpheric preſſure. The motion

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motion of the returning ſtroke is therefore ſo much deranged by this foreign and inappreciated circumſtance, that it would have been quite uſeleſs to engage in the intricate exponential inveſtigation, and we muſt ſit down contented with a leſs perfect adjuſtment of the counter weight and weight of water.—Any perſon who attends to the motion of a ſteam-engine will perceive that the deſcent of the pump-rods is ſo far from being accelerated, that it is nearly uniform, and frequently it is ſenſibly retarded towards the end. We learn by the way, that it is of the utmoſt importance not only to have a quick production of ſteam, but alſo a very capacious dome, or empty ſpace above the water in the boiler. In engines where this ſpace was but four or five times the capacity of the cylinder, we have always obſerved a very ſenſible check given to the deſcent of the pump-rods after having made half their ſtroke. This obliges us to employ a greater counter weight, which diminiſhes the column of water, or retards the working ſtroke; it alſo obliges us to employ a ſtronger ſteam, at the riſk of burſting the boiler, and increaſes the expence of fuel.

42 How to know the elaſticity of the ſteam in the cylinder.

It would be a moſt deſirable thing to get an exact knowledge of the elaſticity of the ſteam in the cylinder; and this is by no means difficult. Take a long glaſs tube exactly calibered, and cloſe at the farther end. Put a ſmall drop of ſome coloured fluid into it, ſo as to ſtand at the middle nearly.—Let it be placed in a long box filled with water to keep it of a conſtant temperature. Let the open end communicate with the cylinder, with a cock between. The moment the ſteam-cock is opened, open the cock of this inſtrument. The drop will be puſhed towards the cloſe end of the tube, while the ſteam in the cylinder is more elaſtic than the air, and it will be drawn the other way while it is leſs elaſtic, and, by a ſcale properly adapted to it, the elaſticity of the ſteam correſponding to every poſition of the piſton may be diſcovered. The ſame thing may be done more accurately by a barometer properly conſtructed, ſo as to prevent the oſcillations of the mercury.

43 Neceſſary alſo to know the ſtate of the cylinder during the deſcent of the piſton.

It is equally neceſſary to know the ſtate of the cylinder during the deſcent of the ſteam-piſton. We have hitherto ſuppoſed P to be the full preſſure of the atmoſphere on the area of the piſton, ſuppoſing the vacuum below it to be complete. But the inſpection of our table of elaſticity ſhows that this can never be the caſe, becauſe the cylinder is always of a temperature far above 32°. We have made many attempts to diſcover its temperature. We have employed a thermometer in cloſe contact with the ſide of the cylinder, which ſoon acquired a ſteady temperature: this was never leſs than 145°. We have kept a thermometer in the water which lies on the piſton: this never ſunk below 135°. It is probable that the cylinder within may be cooled ſomewhat lower; but for this opinion we cannot give any very ſatisfactory reaſon. Suppoſe it cooled down to 120°; this will leave an elaſticity which would ſupport three inches of mercury. We cannot think therefore that the unbalanced preſſure of the atmoſphere exceeds that of 27 inches of mercury, which is about 13$\frac{1}{2}$d pounds on a ſquare inch, or 10$\frac{1}{2}$ on a circular inch. And this is the value which we ſhould employ in the equation $P = L + y$. This queſtion may be decided in the ſame way as the other, by a barometer connected with the inſide of the cylinder.

And thus we ſhall learn the ſtate of the moving forces in every moment of the performance, and the machine will then be as open to our examination as any water or horſe mill; and till this be done, or ſomething equivalent, we can only gueſs at what the machine is actually performing, and we cannot tell in what particulars we can lend it a helping hand. We are informed that Meſſrs Watt and Boulton have made this addition to ſome of their engines; and we are perſuaded that, from the information which they have derived from it, they have been enabled to make the curious improvements from which they have acquired ſo much reputation and profit.

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44 Quantity of cold water to be injected.

There is a circumſtance of which we have as yet taken no notice, viz. the quantity of cold water injected. Here we confeſs ourſelves unable to give any preciſe inſtructions. It is clear at firſt ſight that no more than is abſolutely neceſſary ſhould be injected. It muſt generally be ſupplied by the engine, and this expends part of its power. An exceſs is much more hurtful by cooling the cylinder and piſton too much, and therefore waſting ſteam during the next riſe of the piſton. But the determination of the proper quantity requires a knowledge, which we have not yet acquired, of the quantity of heat contained in the ſteam in a latent form. As much water muſt be injected as will abſorb all this without riſing near to the boiling temperature. But it is of much more importance to know how far we may cool the cylinder with advantage; that is, when will the loſs of ſteam, during the next riſe of the piſton, compenſate for the diminution of its elaſticity during its preſent deſcent? Our table of elaſticities ſhows us, that by cooling the cylinder to 120°, we ſtill leave an elaſticity equal to $\frac{1}{10}$th of the whole power of the engine; if we cool it only to 140, we leave an elaſticity of $\frac{1}{5}$th; if we cool it to a blood-heat, we leave an elaſticity of $\frac{1}{10}$th. It is extremely difficult to chooſe among theſe varieties. Experience, however, informs us, that the beſt engines are thoſe which uſe the ſmalleſt quantities of injection water. We know an exceedingly good engine having a cylinder of 30 inches and a ſix-foot ſtroke, which works with ſomething leſs than $\frac{1}{7}$th of a cubic foot of water at each injection; and we imagine that the quantity ſhould be nearly in the proportion of the capacity of the cylinder. Deſaguliers obſerved, that a very good engine, with a cylinder of 32 inches, worked with 300 inches of water at each injection, which does not much exceed $\frac{1}{6}$th of a cubic foot. Mr Watt's obſervations, by means of the barometer, muſt have given him much valuable information in this particular, and we hope that he will not always withhold them from the public.

45 This examination, though not ſatisfactory, may direct the attention to the principal circumſtances.

We have gone thus far in the examination, in order ſeemingly to aſcertain the motion of the engine when loaded and balanced in any known manner, and in order to diſcover that proportion between the moving power and the load which will produce the greateſt quantity of work. The reſult has been very unſatisfactory, becauſe the computation of the returning ſtroke is acknowledged to be beyond our abilities. But it has given us the opportunity of directing the reader's attention to the leading circumſtances in this inquiry. By knowing the internal ſtate of the cylinder in machines of very different goodneſs, we learn the connection between the ſtate of the ſteam and the performance of the machine; and it is very poſſible that the reſult of a full examination may be, that in ſituations where fuel is expenſive, it may be proper to employ a weak ſteam which will expend leſs fuel, although leſs work is performed

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formed by it. We ſhall ſee this confirmed in the cleareſt manner in ſome particular employments of the new engines invented by Watt and Boulton.

In the mean time, we ſee that the equation which we gave from the celebrated Abbé Boſſut is in every reſpect erroneous even for the purpoſe which he had in view. We alſo ſee that the equation which we ſubſtituted in its place, and which was intended for determining that proportion between the counter-weight and the moving force, and the load which would render the working ſtroke and returning ſtroke of equal duration, is alſo erroneous, becauſe theſe two motions are extremely different in kind, the one being nearly uniform, and the other nearly uniformly accelerated. This being ſuppoſed true, it ſhould follow that the counter weight ſhould be reduced to one half; and we have found this to be very nearly true in ſome good engines which we have examined.

46 An erroneous maxim that the two motions are of equal duration.

We ſhall add but one obſervation more on this head. The practical engineers have almoſt made it a maxim, that the two motions are of equal duration. But the only reaſon which we have heard for the maxim, is, that it is aukward to ſee an engine go otherwiſe. But we doubt exceedingly the truth of this maxim, and, without being able to give any accurate determination, we think that the engine will do more work if the working ſtroke be made ſlower than the returning ſtroke. Suppoſe the engine ſo conſtructed that they are made in equal times; an addition to the counter weight will accelerate the returning ſtroke and retard the working ſtroke. But as the counter-weight is but ſmall in proportion to the unbalanced portion of the atmoſpheric preſſure, which is the moving force of the machine, it is evident that this addition to the counter weight muſt bear a much greater proportion to the counter weight than it does to the moving force, and muſt therefore accelerate the returning ſtroke much more than it retards the working ſtroke, and the time of both ſtrokes taken together muſt be diminiſhed by this addition and the performance of the machine improved; and this muſt be the caſe as long as the machine is not extravagantly loaded. The beſt machine which we have ſeen, in reſpect of performance, raiſes a column of water whoſe weight is very nearly $\frac{2}{3}$ds of the preſſure of the atmoſphere on the piſton, making 11 ſtrokes of ſix feet each *per* minute, and the working ſtroke was almoſt twice as ſlow as the other. This engine had worked pumps of 12 inches, which were changed for pumps of 14 inches, all other things remaining the ſame. In its former ſtate it made from $12\frac{1}{2}$ to $13\frac{1}{2}$ ſtrokes *per* minute, the working ſtroke being conſiderably ſlower than the returning ſtroke. The load was encreaſed, by the change of the pumps, nearly in the proportion of 3 to 4. This had retarded the working ſtroke; but the performance was evidently increaſed in the proportion of 3×13 to 4×11, or of 39 to 44. About 300 pounds were added to the counterweight, which increaſed the number of ſtrokes to more than 12 *per* minute. No ſenſible change could be obſerved in the time of the working ſtroke. The performance was therefore increaſed in the proportion of 39 to 48. We have therefore no heſitation in ſaying, that the ſeemly equality of the two ſtrokes is a ſacrifice to fancy. The engineer who obſerves the working ſtroke to be ſlow, fears that his engine may be thought feeble and unequal to its work; a ſimilar notion has long miſled him in the conſtruction of water-mills, eſpecially of overſhot mills; and, even now, he is ſubmitting with heſitation and fear to the daily correction of experience.

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It is needleſs to engage more deeply in ſcientific calculations in a ſubject where ſo many of the data are ſo very imperfectly underſtood.

47 The load of work ſhould not be leſs than 10 pounds for every ſquare inch of the piſton.

We venture to recommend as a maxim of conſtruction (ſuppoſing always a large boiler and plentiful ſupply of pure ſteam unmixed with air), that the load of work be not leſs than 10 pounds for every ſquare inch of the piſton, and the counterweight ſo proportioned that the time of the returning ſtroke may not exceed $\frac{2}{3}$ds of that of the working ſtroke. A ſerious objection may be made to this maxim, and it deſerves mature conſideration. Such a load requires the utmoſt care of the machine, that no admiſſion be given to the common air; and it precludes the poſſibility of its working in caſe the growth of water, or deepening the pit, ſhould make a greater load abſolutely neceſſary. Theſe conſiderations muſt be left to the prudence of the enginneer. The maxim now recommended relates only to the beſt actual performance of the engine.

48 Rules for computing the performance of the ſteam-engine.

Before quitting this machine, it will not be amiſs to give ſome eaſy rules, ſanctioned by ſucceſsful practice, for computing its performance. Theſe will enable any artiſt, who can go through ſimple calculations, to ſuit the ſize of his engine to the taſk which it is to perform.

The circumſtance on which the whole computation muſt be founded is the quantity of water which muſt be drawn in a minute and the depth of the mine; and the performance which may be expected from a good engine is at leaſt 12 ſtrokes per minute of ſix feet each, working againſt a column of water whoſe weight is equal to half of the atmoſpheric preſſure on the ſteam-piſton, or rather to 7,64 pounds on every ſquare inch of its ſurface.

It is moſt convenient to eſtimate the quantity of water in cubic feet, or its weight in pounds, recollecting that a cubic foot of water weighs $62\frac{1}{2}$ pounds. The depth of the pit is uſually reckoned in fathoms of ſix feet, and the diameter of the cylinder and pump is uſually reckoned in inches.

Let Q be the quantity of water to be drawn per minute in cubical feet, and f the depth of the mine in fathoms; let c be the diameter of the cylinder, and p that of the pump; and let us ſuppoſe the arms of the beam to be of equal length.

1ſt, To find the diameter of the pump, the area of the piſton in ſquare feet is $p^2\times\frac{0,7854}{144}$. The length of the column drawn in one minute is 12 times 6 or 72 feet, and therefore its ſolid contents is $p^2\times\frac{72\times0,7854}{144}$ cubical feet, or $p^2\times0,3927$ cubical feet. This muſt be equal to Q; therefore p^2 muſt be $\frac{Q}{0,3927}$ or nearly $Q\times2\frac{1}{2}$. Hence this practical rule: Multiply the cubic feet of water which muſt be drawn in a minute by $2\frac{1}{2}$, and extract the ſquare root of the product: this will be the diameter of the pump in inches.

Thus ſuppoſe that 58 cubic feet muſt be drawn every minute; 58 multiplied by $2\frac{1}{2}$ gives 145, of which the ſquare-

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square root is 12, which is the required diameter of the pump.

2. To find the proper diameter of the cylinder.

The piston is to be loaded with 7,64 pounds on every square inch. This is equivalent to six pounds on a circular inch very nearly. The weight of a cylinder of water an inch in diameter and a fathom in height is $2\frac{1}{11}$ pounds, or nearly 2 pounds. Hence it follows that $6c^2$ must be made equal to $2fp^2$, and that c^2 is equal to $\frac{2fp^2}{6}$, or to $\frac{fp^2}{3}$.

Hence the following rule: Multiply the square of the diameter of the pump-piston (found as above) by the fathoms of lift, and divide the product by 3, the square root of the quotient is the diameter of the cylinder.

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Suppose the pit to which the foregoing pump is to be applied is 24 fathoms deep; then $\frac{24\times144}{3}$ gives 1152, of which the square root is 34 inches very nearly.

This engine constructed with care will certainly do the work.

Whatever is the load of *water* proposed for the engine, let 10 be the pounds on every circular inch of the steam-piston, and make $c^2=p^2\times\frac{2f}{m}$, and the square root will be the diameter of the steam-piston in inches.

To free the practical engineer as much as possible from all trouble of calculation, we subjoin the following *Table of the Dimensions and Power of the Steam Engine*, drawn up by Mr Beighton in 1717, and fully verified by practice since that time. The measure is in English ale gallons of 282 cubic inches.

49 Mr Beighton's table of the dimensions and power of the steam-engine.

Diam. of pump.	Holds in one yard.	Draws by a 6 feet stroke.	Weighs in one yard.	At 16 strokes per min.	Ditto in hogsheads.	Ditto per hour.	Diameter of cylinder in inches.	The depth to be drawn in yards.											
								15	20	25	30	35	40	45	50	60	70	80	90
Inch.	Gall.	Gall.	Lb. avoir	Gall.	Hd. Gal	Hd. Gall.													
12	14,4	28,8	146	462	7.21	440.		18½	21¾	24	26½	28½	30½	32½	34¼	37¼	40	43½	
11	12,13	24,26	123,5	338	6.20	369.33		17	19¾	22	25	26¼	28	29¼	31¼	34½	37	39½	
10	10,02	20,04	102	320	5.5	304.48		15½	18	20	22	23¾	25¼	27	28¾	31¼	34	36	38½
9	8,12	16,24	82,7	259,8	4.7	247.7		14	16¼	18	20	21½	23	24¼	25	28	30½	33	35
8½	7,26	14,52	73,9	232,3	3.43	221.15		13½	15¼	17¼	19	20¼	21¾	23	24	26¼	28¼	31	32½
8	6,41	12,82	65,3	205,2	3.16	195.22		12½	14½	16½	18½	19	20½	21½	23	25	27	29	30½
7¾	6,01	12,02	61,2	192,3	3.2	182.13		12	14	15½	17½	18¾	19¾	21	22	24¼	26	28	29½
7½	5,66	11,32	57,6	181,1	2.55	172.30		11	13¾	15	16½	18	19	20	21¼	23¼	25	27	28½
7	4,91	9,82	50,0	157,1	2.31	149.40		10¾	13	14	15½	16¾	18¾	19	20½	22	24	25½	27
6½	4,23	8,46	43	135,3	2.9	128.54		10	12	13	14	15½	16¼	18	19	20	22	23	24½
6	3,61	7,2	36,7	115,5	1.52	110.1		9½	11	12	13	14	15½	16	17	19	20½	22	23
5½	3,13	6,2	31,8	99,2	1.36	94.30			10	11	12	13	14	15	15¾	17	19	20	21
5	2,51	5,0	25,5	80,3	1.7	66.61				10	11	11¾	13	13¾	14	15½	16¾	18½	19½
4½	2,02	4,04	20,5	64,6	1.1	60.60					10	11	11¾	12	13½	14	15	16	17
4	1,6	3,2	16,2	51,2	0.51	48.51						9	10	11	11½	12	13½	14	15

The first part of the table gives the size of the pump suited to the growth of water. The second gives the size of the cylinder suited to the load of water. If the depth is greater than any in this table, take its fourth part, and double the diameter of the cylinder. Thus if 150 hogsheads are to be drawn in an hour from the depth of 100 fathoms, the last column of part first gives for 149.40 a pump of 7 inches bore. In a line with this, under the depth of 50 yards, which is $\frac{1}{4}$th of 100 fathoms, we find $20\frac{1}{2}$, the double of which is 41 inches for the diameter of the cylinder.

It is almost impossible to give a general rule for strokes of different lengths, &c. but any one who professes the ability to erect an engine, should surely know as much arithmetic as will accommodate the rule now given to any length of stroke.

We venture to say, that no ordinary engineer can tell *à priori* the number per minute which an engine will give. We took 12 strokes of six feet each for a standard, which a careful engineer may easily accomplish, and which an employer has a right to expect, the engine being loaded with water to half the pressure of the atmosphere: if the load be less, there is some fault — an improper counter weight, or too little boiler, or leaks, &c. &c.

50 Mr Fitzgerald's method of converting its reciprocating motion into a continued rotatory motion.

Such is the state in which Newcomen's steam-engine had continued in use for 60 years neglected by the philosopher, although it is the most curious object which human ingenuity has yet offered to his contemplation, and abandoned to the efforts of the unlettered artist. Its use has been entirely confined to the raising of water. Mr Keane Fitzgerald indeed published in the Philosophical Transactions a method of converting its reciprocating motion into a continued rotatory motion by employing the great beam to work a crank or a train of wheel-work. As the real action of the machine is confined to its working stroke, to accomplish this, it became necessary to connect with the crank or wheeled work a very large and heavy fly, which should accumulate in itself the whole pressure of the machine during its time of action, and therefore continue in motion, and urge forward the working machinery while the steam engine was going through its inactive returning stroke. This will be the case, provided that the resistance exerted by the working machine during the whole period of the working and returning stroke of the steam-engine, together

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with the friction of both, does not exceed the whole preſſure exerted by the ſteam-engine during its working ſtroke; and provided that the momentum of the fly, ariſing from its great weight and velocity, be very great, ſo that the reſiſtance of the work during one returning ſtroke of the ſteam-engine do not make any very ſenſible diminution of the velocity of the fly. This is evidently poſſible and eaſy. The fly may be made of any magnitude; and being exactly balanced round its axis, it will ſoon acquire any velocity conſiſtent with the motion of the ſteam-engine. During the working ſtroke of the engine it is uniformly accelerated, and by its acquired momentum it produces in the beam the movement of the returning ſtroke; but in doing this, its momentum is ſhared with the inert matter of the ſteam-engine, and conſequently its velocity diminiſhed, but not entirely taken away. The next working ſtroke therefore, by preſſing on it afreſh, increaſes its remaining velocity by a quantity nearly equal to the whole that it acquired during the firſt ſtroke. We ſay *nearly*, but not quite equal, becauſe the time of the ſecond working ſtroke muſt be ſhorter than that of the firſt, on account of the velocity already in the machine. In this manner the fly will be more and more accelerated every ſucceeding ſtroke, becauſe the preſſure of the engine during the working ſtroke does more than reſtore to the fly the momentum which it loſt in producing the returning movement of the ſteam-engine. Now ſuppoſe the working part of the machine to be added. The acceleration of the fly during each working ſtroke of the ſteam-engine will be leſs than it was before, becauſe the impelling preſſure is now partly employed in driving the working machine, and becauſe the fly will loſe more of its momentum during the returning ſtroke of the ſteam-engine, part of it being expended in driving the working machine. It is evident, therefore, that a time will come when the ſucceſſive augmentation of the fly's velocity will ceaſe; for, on the one hand, the continual acceleration diminiſhes the time of the next working ſtroke, and therefore the time of action of the accelerating power. The acceleration muſt diminiſh in the ſame proportion; and on the other hand, the reſiſtance of the working machine generally, though not always, increaſes with its velocity. The acceleration ceaſes whenever the addition made to the momentum of the fly during a working ſtroke of the ſteam-engine is juſt equal to what it loſes by driving the machine, and by producing the returning movement of the ſteam-engine.

51 An important addition;

This muſt be acknowledged to be a very important addition to the engine, and though ſufficiently obvious, it is ingenious, and requires conſiderable ſkill and addreſs to make it effective (B).

The movement of the working machine, or mill of whatever kind, muſt be in ſome degree hobbling or unequal. But this may be made quite inſenſible, by making the fly exceedingly large, and diſpoſing the greateſt part of its weight in the rim. By theſe means its momentum may be made ſo great, that the whole force required for driving the mill and producing the returning movement of the engine may bear a very ſmall proportion to it. The diminution of its velocity will then be very trifling.

No counter weight is neceſſary here, becauſe the returning movement is produced by the inertia of the fly. A counter weight may, however, be employed, and ſhould be employed, viz. as much as will produce the returning movement of the ſteam-engine. It will do this better than the ſame force accumulated in the fly; for this force muſt be accumulated in the fly by the intervention of rubbing parts, by which ſome of it is loſt; and it muſt be afterwards returned to the engine with a ſimilar loſs. But, for the ſame reaſon, it would be improper to make the counter weight alſo able to drive the mill during the returning ſtroke.

52 But ſeldom or never adopted.

By this contrivance Mr Fitzgerald hoped to render the ſteam-engine of moſt extenſive uſe; and he, or others aſſociated with him, obtained a patent excluding all others from employing the ſteam-engine for turning a crank. They alſo publiſhed propoſals for erecting mills of all kinds driven by ſteam-engines, and ſtated very fairly their powers and their advantages. But their propoſals do not ſeem to have acquired the confidence of the public; for we do not know of any mill ever having been erected under this patent.

53 The great expenſe of fuel

The great obſtacle to this extenſive uſe of the ſteam-engine is the prodigious expenſe of fuel. An engine having a cylinder of four feet diameter, working night and day, conſumes about 3400 chaldron (London) of good coals in a year.

54 Limits the uſe of ſteam-engines.

This circumſtance limits the uſe of ſteam-engines exceedingly. To draw water from coal-pits, where they can be ſtocked with unſaleable ſmall coal, they are of univerſal employment: alſo for valuable mines, for ſupplying a great and wealthy city with water, and a few other purpoſes where a great expence can be borne, they are very proper engines; but in a thouſand caſes where their unlimited powers might be vaſtly ſerviceable, the enormous expenſes of fuel completely excludes them. We cannot doubt but that the attention of engineers was much directed to every thing that could promiſe a diminution of this expenſe. Every one had his particular noſtrum for the conſtruction of his furnace, and ſome were undoubtedly more ſucceſsful than others. But ſcience was not yet ſufficiently advanced: It was not till Dr Black had made his beautiful diſcovery of latent heat, that we could know the intimate relation between the heat expended in boiling off a quantity of water and the quantity of ſteam that is produced.

(B) We do not recollect at preſent the date of this propoſal of Mr Fitzgerald; but in 1781 the Abbé Arnal, canon of Alais in Languedoc, entertained a thought of the ſame kind, and propoſed it for working lighters in the inland navigations; a ſcheme which has been ſucceſsfully practiſed (we are told) in America. His brother, a major of engineers in the Auſtrian ſervice, has carried the thing much farther, and applied it to manufactures; and the Aulic Chamber of Mines at Vienna has patronized the project: (See *Journal Encyclopedique*, 1781). But theſe ſchemes are long poſterior to Mr Fitzgerald's patent, and are even later than the erection of ſeveral machines driven by ſteam-engines which have been erected by Meſſrs Watt and Boulton. We think it our duty to ſtate theſe particulars, becauſe it is very uſual for our neighbours on the continent to aſſume the credit of Britiſh inventions.

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Much about the time of this discovery, viz. 1763, Mr James Watt, established in Glasgow in the commercial line, was amusing himself with repairing a working model of the steam-engine which belonged to the philosophical apparatus of the university. Mr Watt was a person of a truly philosophical mind, eminently conversant in all branches of natural knowledge, and the pupil and intimate friend of Dr Black. In the course of the above mentioned amusement many curious facts in the production and condensation of steam occurred to him; and among others, that remarkable fact which is always appealed to by Dr Black as the proof of the immense quantity of heat which is contained in a very minute quantity of water in the form of elastic steam. When a quantity of water is heated several degrees above the boiling point in a close digester, if a hole be opened, the steam rushes out with prodigious violence, and the heat of the remaining water is reduced, in the course of three or four seconds, to the boiling temperature. The water of the steam which has issued amounts only to a very few drops; and yet these have carried off with them the whole excess of heat from the water in the digester.

55 Mr Watt discovers that steam contains an immense quantity of heat

56 In his attempts to find out a way to husband this heat,

Since then a certain quantity of steam contains so great a quantity of heat, it must expend a great quantity of fuel; and no construction of furnace can prevent this. Mr Watt therefore set his invention to work to discover methods of husbanding this heat. The cylinder of his little model was heated almost in an instant, so that it could not be touched by the hand. It could not be otherwise, because it condensed the vapour by abstracting its heat. But all the heat thus communicated to the cylinder, and wasted by it on surrounding bodies, contributed nothing to the performance of the engine, and must be taken away at every injection, and again communicated and wasted. Mr Watt quickly understood the whole process which was going on within the cylinder, and which we have considered so minutely, and saw that a very considerable portion of the steam must be wasted in warming the cylinder. His first attempts were made to ascertain how much was thus wasted, and he found that it was not less than three or four times as much as would fill the cylinder and work the engine. He attempted to diminish this waste by using wooden cylinders. But though this produced a sensible diminution of the waste, other reasons forced him to give them up. He then cased his metal cylinders in a wooden case with light wood ashes between. By this, and using no more injection than was absolutely necessary for the condensation, he reduced the waste almost one half. But by using so small a quantity of cold water, the inside of the cylinder was hardly brought below the boiling temperature; and there consequently remained in it a steam of very considerable elasticity, which robbed the engine of a proportional part of the atmospherical pressure. He saw that this was unavoidable as long as the condensation was performed in the cylinder. The thought struck

57 Discovers a method of condensing the steam at a little distance from the cylinder,

him to attempt the condensation in another place. His first experiment was made in the simplest manner. A globular vessel communicated by means of a long pipe of one inch diameter with the bottom of his little cylinder of four inches diameter and 30 inches long. This pipe had a stop-cock, and the globe was immersed in a vessel of cold water. When the piston was at the top, and the cylinder filled with strong steam, he turned the cock. It was scarcely turned, nay he did not think it completely turned, when the sides of his cylinder (only strong tin-plate) were crushed together like an empty bladder. This surprised and delighted him. A new cylinder was immediately made of brass sufficiently thick, and nicely bored. When the experiment was repeated with this cylinder, the condensation was so rapid, that he could not say that any time was expended in it. But the most valuable discovery was, that the vacuum in the cylinder was, as he hoped, almost perfect. Mr Watt found, that when he used water in the boiler purged of air by long boiling, nothing that was very sensibly inferior to the pressure of the atmosphere on the piston could hinder it from coming quite down to the bottom of the cylinder. This alone was gaining a great deal, for in most engines the remaining elasticity of the steam was not less than $\frac{1}{8}$th of the atmospherical pressure, and therefore took away $\frac{1}{8}$th of the power of the engine.

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58 And removes the difficulties which attended this improvement by means of pumps.

Having gained this capital point, Mr Watt found many difficulties to struggle with before he could get the machine to continue its motion. The water produced from the condensed steam, and the air which was extricated from it, or which penetrated through unavoidable leaks, behoved to accumulate in the condensing vessel, and could not be voided in any way similar to that adopted in Newcomen's engine. He took another method: He applied pumps to extract both, which were worked by the great beam. The contrivance is easy to any good mechanic; only we must observe, that the piston of the water-pump must be under the surface of the water in the condenser, that the water may enter the pump by its own weight, because there is no atmospherical pressure there to force it in. We must also observe, that a considerable force is necessarily expended here, because, as there is but one stroke for rarefying the air, and this rarefaction must be nearly complete, the air-pump must be of large dimensions, and its piston must act against the whole pressure of the atmosphere. Mr Watt, however, found that this force could be easily spared from his machine, already so much improved in respect of power.

59 Observations on the advantages of these discoveries.

Thus has the steam-engine received a very considerable improvement. The cylinder may be allowed to remain very hot; nay, boiling hot, and yet the condensation be completely performed. The only elastic steam that now remains is the small quantity in the pipe of communication. Even this small quantity Mr Watt at last got rid of, by admitting a small jet of cold water up this pipe to meet the steam in its passage to the condenser. This both cooled this part of the apparatus in a situation where it was not necessary to warm it again, and it quickened the condensation. He found at last that the small pipe of communication was of itself sufficiently large for the condensation, and that no separate vessel, under the name of condenser, was necessary. This circumstance shows the prodigious rapidity of the condensation. We may add, that unless this had been the case, his improvement would have been vastly diminished; for a large condenser would have required a much larger air-pump, which would have expended much of the power of the engine. By these means the vacuum below the piston is greatly improved: for it will appear clear to any person who understands the subject, that as long as any part of the condenser is

kept

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kept of a low temperature, it will abſtract and condenſe the vapour from the warmer parts, till the whole acquires the elaſticity correſponding to the coldeſt part. By the ſame means much of the waſte is prevented, becauſe the cylinder is never cooled much below the boiling temperature. Many engines have been erected by Mr Watt in this form, and their performance gave univerſal ſatisfaction.

We have contented ourſelves with giving a very ſlight deſcription without a figure of this improved engine, becauſe we imagine it to be of very eaſy comprehenſion, and becauſe it is only a preparation for ſtill greater improvements, which, when underſtood, will at the ſame time leave no part of this more ſimple form unexplained.

60 Mr Watt makes the piſton deſcend by the force of ſteam.

During the progreſs of theſe improvements Mr Watt made many experiments on the quantity and denſity of the ſteam of boiling water. Theſe fully convinced him, that although he had greatly diminiſhed the waſte of ſteam, a great deal yet remained, and that the ſteam expended during the riſe of the piſton was at leaſt three times more than what would fill the cylinder. The cauſe of this was very apparent. In the ſubſequent deſcent of the piſton, covered with water much below the boiling temperature, the whole cylinder was neceſſarily cooled and expoſed to the air. Mr Watt's fertile genius immediately ſuggeſted to him the expedient of employing the elaſticity of the ſteam from the boiler to impel the piſton down the cylinder, in place of the preſſure of the atmoſphere; and thus he reſtored the engine to its firſt principles, making it an engine *really moved by ſteam*. As this is a new epoch in its hiſtory, we ſhall be more particular in the deſcription; at the ſame time ſtill reſtricting ourſelves to the eſſential circumſtances, and avoiding every peculiarity which is to be found in the prodigious varieties which Mr Watt has introduced into the machines which he has erected, every individual of which has been adapted to local circumſtances, or diverſified by the progreſs of Mr Watt's improvements.

Plate CCCCLXXVIII.

61 Deſcription of the machine after theſe improvements were added.

Let A (fig. 9.) repreſent the boiler. This has received great improvements from his complete acquaintance with the procedure of nature in the production of ſteam. In ſome of his engines the fuel has been placed in the midſt of the water, ſurrounded by an iron or copper veſſel, while the exterior boiler was made of wood, which tranſmits, and therefore waſtes the heat very ſlowly. In others, the flame not only plays round the whole outſide, as in common boilers, but alſo runs along ſeveral flues which are conducted through the midſt of the water. By ſuch contrivances the fire is applied to the water in a moſt extenſive ſurface, and for a long time, ſo as to impart to it the greateſt part of its heat. So ſkilfully was it applied in the Albion Mills, that although it was perhaps the largeſt engine in the kingdom, its unconſumed ſmoke was inferior to that of a very ſmall brew-houſe. In this ſecond engine of Mr Watt, the top of the cylinder is ſhut up by a ſtrong metal plate *g h*, in the middle of which is a collar or box of leathers *k l*, formed in the uſual manner of a jack-head pump, through which the piſton rod P D, nicely turned and poliſhed, can move up and down, without allowing any air to paſs by its ſides. From the dome of the boiler proceeds a large pipe B C I O Q, which, after reaching the cylinder with its horizontal part B C, deſcends parallel to its ſide, ſending off two branches, *viz.* I M to the top of the cylinder, and O N to its bottom. At I is a puppet valve opening from below upwards. At L, immediately below this branch, there is a ſimilar valve, alſo opening from below upwards. The pipe deſcends to Q, near the bottom of a large ciſtern *c d e f*, filled with cold water conſtantly renewed. The pipe is then continued horizontally along the bottom of this ciſtern (but not in contact), and terminates at R in a large pump S T. The piſton S has clack valves opening upwards, and its rod S *s*, paſſing through a collar of leathers at T, is ſuſpended by a chain to a ſmall arch head on the outer arm of the beam. There is a valve R in the bottom of this pump, as uſual, which opens when preſſed in the direction Q R, and ſhuts againſt a contrary preſſure. This pump delivers its contents into another pump X Y, by means of the ſmall pipe *t* X, which proceeds from its top. This ſecond pump has a valve at X, and a clack in its piſton Z as uſual, and the piſton rod Z *z* is ſuſpended from another arch head on the outer arm of the beam. The two valves I and L are opened and ſhut by means of ſpanners and handles, which are put in motion by a plug frame, in the ſame manner as in Newcomen's engine.

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Laſtly, there may be obſerved a crooked pipe *a b o*, which enters the upright pipe laterally a little above Q. This has a ſmall jet hole at *o*; and the other end *a*, which is conſiderably under the ſurface of the water of the condenſing ciſtern, is covered with a puppet valve *v*, whoſe long ſtalk *v u* riſes above the water, and may be raiſed or lowered by hand or by the plug beam. The valves R and X and the clacks in the piſtons S and Z are opened or ſhut by the preſſures to which they are immediately expoſed.

This figure is not an exact copy of any of Mr Watt's engines, but has its parts ſo diſpoſed that all may come diſtinctly into view, and exactly perform their various functions. It is drawn in its quieſcent poſition, the outer end of the beam preponderating by the counter weight, and the piſton P at the top of the cylinder, and the piſtons S and Z in their loweſt ſituations.

In this ſituation let us ſuppoſe that a vacuum is (by any means) produced in all the ſpace below the piſton, the valve I being ſhut. It is evident that the valve R will alſo be ſhut, as alſo the valve *v*. Now let the valve I be opened. The ſteam from the boiler, as elaſtic as common air, will ruſh into the ſpace above the piſton, and will exert on it a preſſure as great as that of the atmoſphere. It will therefore preſs it down, raiſe the outer end of the beam, and cauſe it to perform the ſame work as an ordinary engine.

When the piſton P has reached the bottom of the cylinder, the plug frame ſhuts the valve I, and opens L. By ſo doing the communication is open between the top and bottom of the cylinder, and nothing hinders the ſteam which is above the piſton from going along the paſſage M L O N. The piſton is now equally affected on both ſides by the ſteam, even though a part of it is continually condenſed by the cylinder, and in the pipe I O Q. Nothing therefore hinders the piſton from being dragged up by the counter weight, which acts with its whole force, undiminiſhed by any remaining unbalanced elaſticity of ſteam. Here therefore this form of the engine has an advantage (and by no means

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a ſmall one) over the common engines, in which a great part of the counter weight is expended in overcoming unbalanced atmoſpheric preſſure.

Whenever the piſton P arrives at the top of the cylinder, the valve L is ſhut by the plug frame, and the valves I and *v* are opened. All the ſpace below the piſton is at this time occupied by the ſteam which came from the upper part of the cylinder. This being a little waſted by condenſation, is not quite a balance for the preſſure of the atmoſphere. Therefore, during the aſcent of the piſton, the valve R was ſhut, and it remains ſo. When, therefore, the valve *v* is opened, the cold water of the ciſtern muſt ſpout up through the hole *o*, and condenſe the ſteam. To this muſt be added the coldneſs of the whole pipe O Q S. As faſt as it is condenſed, its place is ſupplied by ſteam from the lower part of the cylinder. We have already remarked, that this ſucceſſive condenſation is accompliſhed with aſtoniſhing rapidity. In the mean time, ſteam from the boiler preſſes on the upper ſurface of the piſton. It muſt therefore deſcend as before, and the engine muſt perform a ſecond working ſtroke.

But in the mean time the injection water lies in the bottom of the pipe O Q R, heated to a conſiderable degree by the condenſation of the ſteam; alſo a quantity of air has been diſengaged from it and from the water in the boiler. How is this to be diſcharged?—This is the office of the pumps S T and X Y. The capacity of S T is very great in proportion to the ſpace in which the air and water are lodged. When, therefore, the piſton S has got to the top of its courſe, there muſt be a vacuum in the barrel of this pump, and the water and air muſt open the valve R and come into it. When the piſton S comes down again in the next returning ſtroke, this water and air gets through the valve of the piſton; and in the next working ſtroke they are diſcharged by the piſton into the pump X Y, and raiſed by its piſton. The air eſcapes at Y, and as much of the water as is neceſſary is delivered into the boiler by a ſmall pipe Y *g* to ſupply its waſte. It is a matter of indifference whether the piſtons S and Z riſe with the outer or inner end of the beam, but it is rather better that they riſe with the inner end. They are otherwiſe drawn here, in order to detach them from the reſt and ſhow them more diſtinctly.

Such is Mr Watt's ſecond engine. Let us examine its principles, that we may ſee the cauſes of its avowed and great ſuperiority over the common engines.

62 Cauſes of its ſuperiority over common engines are, the full operation of the counter weight,

We have already ſeen one ground of ſuperiority, the full operation of the counter weight. We are authorized by careful examination to ſay, that in the common engines at leaſt one-half of the counter weight is expended in counteracting an unbalanced preſſure of the air on the piſton during its aſcent. In many engines, which are not the worſt, this extends to $\frac{1}{5}$th of the whole preſſure. This is evident from the examination of the engine at Montrelais by Boſſut. This makes a very great counter weight neceſſary, which exhauſts a proportional part of the moving force.

63 And great ſaving of ſteam,

But the great advantage of Mr Watt's form is the almoſt total annihilation of the waſte of ſteam by condenſation in the cylinder. The cylinder is always boiling hot, and therefore perfectly dry. This muſt be evident to any perſon who underſtands the ſubject. By the time that Mr Watt had completed his improvements, his experiments on the production of ſteam had given him a pretty accurate knowledge of its denſity; and he found himſelf authorized to ſay, that the quantity of ſteam employed did not exceed twice as much as would fill the cylinder, ſo that not above one-half was unavoidably waſted. But before he could bring the engine to this degree of perfection, he had many difficulties to overcome; He incloſed the cylinder in an outer wooden caſe at a ſmall diſtance from it. This diminiſhed the expence of heat by communication to ſurrounding bodies. Sometimes he allowed the ſteam from the boiler to occupy this interval. This undoubtedly prevented all diſſipation from the inner cylinder; but in its turn it diſſipated much heat by the outer caſe, and a very ſenſible condenſation was obſerved between them. This has occaſioned him to omit this circumſtance in ſome of his beſt engines. We believe it was omitted in the Albion Mills.

The greateſt difficulty was to make the great piſton tight. The old and effectual method, by water lying on it, was inadmiſſible. He was therefore obliged to have his cylinders moſt nicely bored, perfectly cylindrical, and finely poliſhed; and he made numberleſs trials of different ſoft ſubſtances for packing his piſton, which ſhould be tight without enormous friction, and which ſhould long remain ſo, in a ſituation perfectly dry, and hot almoſt to burning.

After all that Mr Watt has done in this reſpect, he thinks that the greateſt part of the waſte of ſteam which he ſtill perceives in his engines ariſes from the unavoidable eſcape by the ſides of the piſton during its deſcent.

But the fact is, that an engine of this conſtruction, of the ſame dimenſions with a common engine, making the ſame number of ſtrokes of the ſame extent, does not conſume above one fourth part of the fuel that is conſumed by the beſt engines of the common form. It is alſo a very fortunate circumſtance, that the performance of the engine is not immediately deſtroyed, nor indeed ſenſibly diminiſhed, by a ſmall want of tightneſs in the piſton. In the common engine, if air get in, in this way, it immediately puts a ſtop to the work; but although even a conſiderable quantity of ſteam get paſt the piſton during its deſcent, the rapidity of condenſation is ſuch, that hardly any diminution of preſſure can be obſerved, and the waſte of ſteam is the only inconvenience.

64 Another valuable property of it

Mr Watt's penetration ſoon diſcovered another moſt valuable property of this engine. When an engine of the common form is erected, the engineer muſt make an accurate eſtimate of the work to be performed, and muſt proportion his engine accordingly. He muſt be careful that it be *fully* able to execute its taſk; but its power muſt not exceed its load in any extravagant degree. This would produce a motion which is too rapid, and which, being alternately in oppoſite directions, would occaſion jolts which no building or machinery could withſtand. Many engines have been ſhattered by the pumps drawing air, or a pump-rod breaking; by which accidents the ſteam-piſton deſcends with ſuch rapidity that every thing gives way. But in moſt operations of mining, the taſk of the engine increaſes, and it muſt be ſo conſtructed at firſt as to be able to bear this addition. It is very difficult to manage an engine that is much ſuperior to its taſk; and the eaſieſt way is,

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to have it almoſt full loaded, and to work it only during a few hours each day, and allow the pit water to accumulate during its repoſe. This increaſes the firſt coſt, and waſtes fuel during the inaction of the engine.

65 Is, that it can always be exactly fitted to the load which happens to be on it.

But this new engine can at all times be exactly fitted (at leaſt during the working ſtroke) to the load of work that then happens to be on it. We have only to adminiſter ſteam of a proper elaſticity. At the firſt erection the engine may be equal to twice its taſk, if the ſteam admitted above the cylinder be equal to that of common boiling water; but when once the ebullition is fairly commenced, and the whole air expelled from all parts of the apparatus, it is evident, that by damping the fire, ſteam of half this elaſticity may be continually ſupplied, and the water will continue boiling although its temperature does not exceed 185° of Fahrenheit's thermometer. This appears by inſpecting our table of vaporous elaſticity, and affords another argument for rendering that table more accurate by new experiments. We hope that Mr Watt will not withhold from the public the knowledge which he has acquired on this ſubject. It may very poſſibly reſult from an accurate inveſtigation, that it would be adviſable to work our ſteam-engines with weak ſteams, and that the diminution of work may be more than compenſated by the diminution of fuel. It is more probable indeed, and it is Mr Watt's opinion, that the contrary is the caſe, and that it is much more economical to employ great heats. At any rate, the deciſion of this queſtion is of great importance for improving the engine; and we ſee, in the mean time, that the engine can at all times be fitted ſo as to perform its taſk with a moderate and manageable motion, and that as the taſk increaſes we can increaſe the power of the engine.

66 One inconvenience

But the method now propoſed has a great inconvenience. While the ſteam is weaker than the atmoſphere, there is an external force tending to ſqueeze in the ſides and bottom of the boiler. This could not be reſiſted when the difference is conſiderable, and common air would ruſh in through every crevice of the boiler and ſoon choke the engine: it muſt therefore be given up.

67 Remedied in ſome degree.

But the ſame effect will be produced by diminiſhing the paſſage for the ſteam into the cylinder. For this purpoſe, the puppet valve by which the ſteam enters the cylinder was made in the form of a long taper ſpigot, and it was lodged in a cone of the ſame ſhape; conſequently the paſſage could be enlarged or contracted at pleaſure by the diſtance to which the inner cone was drawn up.

68 But the remedy attended with ſome difficulties;

In this way ſeveral engines were conſtructed, and the general purpoſe of ſuiting the power of the engine to its taſk was completely anſwered; but (as the mathematical reader will readily perceive) it was extremely difficult to make this adjuſtment preciſe and conſtant. In a great machine like this, going by jerks, it was hardly poſſible that every ſucceſſive motion of the valve ſhould be preciſely the ſame. This occaſioned very ſenſible irregularities in the motion of the engine, which increaſed and became hazardous when the joints worked looſe by long uſe.

69 Which Mr Watt's fertile genius completely removes.

Mr Watt's genius, always fertile in reſources, found out a complete remedy for all theſe inconveniences. Making the valve of the ordinary form of a puppet clack, he adjuſted the button of its ſtalk or tail ſo that it ſhould always open full to the ſame height. He then regulated the pins of the plug-frame, in ſuch a manner that the valve ſhould ſhut the moment that the piſton had deſcended a certain proportion (ſuppoſe one-fourth, one-third, one-half, &c.) of the cylinder. So far the cylinder was occupied by ſteam as elaſtic as common air. In preſſing the piſton farther down, it behoved the ſteam to expand, and its elaſticity to diminiſh. It is plain that this could be done in any degree we pleaſe, and that the adjuſtment can be varied in a minute, according to the exigency of the caſe, by moving the plug pins.

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In the mean time, it muſt be obſerved, that the preſſure on the piſton is continually changing, and conſequently the accelerating force. The motion therefore will no longer be uniformly accelerated: it will approach much faſter to uniformity; nay, it may be retarded, becauſe although the preſſure on the piſton at the beginning of the ſtroke may exceed the reſiſtance of the load, yet when the piſton is near the bottom the reſiſtance may exceed the preſſure. Whatever may be the law by which the preſſure on the piſton varies, an ingenious mechanic may contrive the connecting machinery in ſuch a way that the chains or rods at the outer end of the beam ſhall continually exert the ſame preſſure, or ſhall vary their preſſure according to any law he finds moſt convenient. It is in this manner that the watchmaker, by the form of the fuzee, produces an equal preſſure on the wheel-work by means of a very unequal action of the main-ſpring. In like manner, by making the outer arch heads portions of a proper ſpiral inſtead of a circle, we can regulate the force of the beam at pleaſure.

Thus we ſee how much more manageable an engine is in this form than Newcomen's was, and alſo more eaſily inveſtigated in reſpect of its power in its various poſitions. The knowledge of this laſt circumſtance was of mighty conſequence, and without it no notion could be formed of what it could perform. This ſuggeſted to Mr Watt the uſe of the barometer communicating with the cylinder; and by the knowledge acquired by theſe means has the machine been ſo much improved by its ingenious inventor.

We muſt not omit in this place one deduction made by Mr Watt from his obſervations, which may be called a diſcovery of great importance in the theory of the engine.

70 A diſcovery of Mr Watt of great importance in the theory of the engine.

Let ABCD (fig. 10.) repreſent a ſection of the cylinder of a ſteam-engine, and EF the ſurface of its piſton. Let us ſuppoſe that the ſteam was admitted while EF was in contact with AB, and that as ſoon as it had preſſed it down to the ſituation EF the ſteam-cock is ſhut. The ſteam will continue to preſs it down, and as the ſteam expands its preſſure diminiſhes. We may expreſs its preſſure (exerted all the while the piſton moves from the ſituation AB to the ſituation EF) by the line EF. If we ſuppoſe the elaſticity of the ſteam proportional to its denſity, as is nearly the caſe with air, we may expreſs the preſſure on the piſton in any other poſition, ſuch as KL or DC, by Kl and Dc, the ordinates of a rectangular hyperbola Fc, of which AE, AB are the aſſymptotes, and A the centre. The accumulated preſſure during the motion of the piſton from EF to DC will be expreſſed by the area $EFcDE$, and the preſſure during the whole motion by the area $ABFcDA$.

Now

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Now it is well known that the area EFcDE is equal to ABFE multiplied by the hyperbolic logarithm of $\frac{AD}{AE}$, $= L.\frac{AD}{AE}$, and the whole area ABFcDA is $= ABFE \times \left(1 + L.\frac{AD}{AE}\right)$.

Thus let the diameter of the piſton be 24 inches, and the preſſure of the atmoſphere on a ſquare inch be 14 pounds; the preſſure on the piſton is 6333 pounds. Let the whole ſtroke be 6 feet, and let the ſteam be ſtopped when the piſton has deſcended 18 inches, or 1,5 feet. The hyperbolic logarithm of $\frac{6}{1,5}$ is 1,3862943. Therefore the accumulated preſſure ABFcDA is $=$ $6333 \times 2,3862943$, $= 15114$ pounds.

As few profeſſional engineers are poſſeſſed of a table of hyperbolic logarithms, while tables of common logarithms are or ſhould be in the hands of every perſon who is much engaged in mechanical calculations, let the following method be practiſed. Take the common logarithm of $\frac{AD}{AE}$, and multiply it by 2,3026; the product is the hyperbolic logarithm of $\frac{AD}{AE}$.

The accumulated preſſure while the piſton moves from AB to EF is 6333×1, or ſimply 6333 pounds. Therefore the ſteam while it expands into the whole cylinder adds a preſſure of 8781 pounds.

Suppoſe that the ſteam had got free admiſſion during the whole deſcent of the piſton, the accumulated preſſure would have been 6333×4, or 25332 pounds.

Here Mr Watt obſerved a remarkable reſult. The ſteam expended in this caſe would have been four times greater than when it was ſtopped at $\frac{1}{4}$th, and yet the accumulated preſſure is not twice as great, being nearly $\frac{5}{9}$ds. One-fourth of the ſteam performs nearly $\frac{1}{7}$ths of the work, and an equal quantity performs more than twice as much work when thus admitted during $\frac{1}{4}$th of the motion.

This is a curious and an important information, and the advantage of this method of working a ſteam-engine increaſes in proportion as the ſteam is ſooner ſtopped; but the increaſe is not great after the ſteam is rarefied four times. The curve approaches near to the axis, and ſmall additions are made to the area. The expenſe of ſuch great cylinders is conſiderable, and may ſometimes compenſate this advantage.

Let the ſteam be ſtopped at	Its performance is mult.
$\frac{1}{2}$ - -	1,7
$\frac{1}{3}$ - -	2,1
$\frac{1}{4}$ - -	2,4
$\frac{1}{5}$ - -	2,6
$\frac{1}{6}$ - -	2,8
$\frac{1}{7}$ - -	3,
$\frac{1}{8}$ - -	3,2
&c.	&c.

It is very pleaſing to obſerve ſo many unlooked-for advantages reſulting from an improvement made with the ſole view of leſſening the waſte of ſteam by condenſation. While this purpoſe is gained, we learn how to huſband the ſteam which is not thus waſted. The engine becomes more manageable, and is more eaſily adapted to every variation in its taſk, and all its powers are more eaſily computed.

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The active mind of its ingenious inventor did not ſtop here: It had always been matter of regret that one-half of the motion was unaccompanied by any work. It was a very obvious thing to Mr Watt, that as the ſteam admitted above the piſton preſſed it down, ſo ſteam admitted below the piſton preſſed it up with the ſame force, provided that a vacuum were made on its upper ſide. This was eaſily done, by connecting the lower end of the cylinder with the boiler and the upper end with the condenſer.

Plate CCCCLXXII. 71 Deſcription of Mr Watt's ſteam-engine in its moſt improved ſtate.

Fig. 11. is a repreſentation of this conſtruction exactly copied from Mr Watt's figure accompanying his ſpecification. Here BB is a ſection of the cylinder, ſurrounded at a ſmall diſtance by the caſe 1111. The ſection of the piſton A, and the collar of leathers which embraces the piſton rod, gives a diſtinct notion of its conſtruction, of the manner in which it is connected with the piſton-rod, and how the packing of the piſton and collar contributes to make all tight.

From the top of the cylinder proceeds the horizontal pipe. Above the letter D is obſerved the ſeat of the ſteam valve, communicating with the box above it. In the middle of this may be obſerved a dark ſhaded circle. This is the mouth of the upper branch of the ſteam pipe coming from the boiler. Beyond D, below the letter N, is the ſeat of the upper condenſing valve. The bottom of the cylinder is made ſpherical, fitting the piſton, ſo that they may come into entire contact. Another horizontal pipe proceeds from this bottom. Above the letter E is the ſeat of the lower ſteam valve, opening into the valve box. This box is at the extremity of another ſteam pipe marked C, which branches off from the upper horizontal part, and deſcends obliquely, coming forward to the eye. The lower part is repreſented as cut open, to ſhow its interior conformation. Beyond this ſteam valve, and below the letter F, may be obſerved the ſeat of the lower condenſing valve. A pipe deſcends from hence, and at a ſmall diſtance below unites with another pipe GG, which comes down from the upper condenſing valve N. Theſe two eduction-pipes thus united go downwards, and open at L into a rectangular box, of which the end is ſeen at L. This box goes backward from the eye, and at its farther extremity communicates with the air-pump K, whoſe piſton is here repreſented in ſection with its butterfly valves. The piſton delivers the water and air laterally into another rectangular box M, darkly ſhaded, which box communicates with the pump I. The piſton-rods of this and of the air-pump are ſuſpended by chains from a ſmall arch head on the inner arm of the great beam. The lower part of the eduction-pipe, the horizontal box L, the air-pump K, with the communicating box M between it and the pump I, are all immerſed in the cold water of the condenſing ciſtern. The box L is made flat, broad, and ſhallow, in order to increaſe its ſurface and accelerate the condenſation. But that this may be performed with the greateſt expedition, a ſmall pipe H, open below (but occaſionally ſtopped by a plug valve), is inſerted laterally into the eduction-pipe G, and then divides into two branches; one of which reaches within a foot or two of the upper valve N, and the other approaches as near to the valve F.

As it is intended by this conſtruction to give the piſton a ſtrong impulſe in both directions, it will not be

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proper to ſuſpend its rod by a chain from the great beam; for it muſt not only pull down that end of the beam, but alſo puſh it upwards. It may indeed be ſuſpended by double chains like the piſtons of the engines for extinguiſhing fires; and Mr Watt has accordingly done ſo in ſome of his engines. But in his drawing from which this figure is copied, he has communicated the force of the piſton to the beam by means of a toothed rack OO, which engages or works in the toothed ſector QQ on the end of the beam. The reader will underſtand, without any farther explanation, how the impulſe given to the piſton in either direction is thus tranſmitted to the beam without diminution. The fly XX, with its pinion Y, which alſo works in the toothed arch QQ, may be ſuppoſed to be removed for the preſent, and will be conſidered afterwards.

We ſhall take the preſent opportunity of deſcribing Mr Watt's method of communicating the force of the ſteam-engine to any machine of the rotatory kind. VV repreſents the rim and arms of a very large and heavy metalline fly. On its axis is the concentric toothed wheel U. There is attached to the end of the great beam a ſtrong and ſtiff rod TT, to the lower end of which a toothed wheel W is firmly fixed by two bolts, ſo that it cannot turn round. This wheel is of the ſame ſize and in the ſame vertical plane with the wheel U; and an iron link or ſtrap (which cannot be ſeen here, becauſe it is on the other ſide of the two wheels) connects the centres of the two wheels, ſo that the one cannot quit the other. The engine being in the poſition repreſented in the figure, ſuppoſe the fly to be turned once round by any external force in the direction of the darts. It is plain, that ſince the toothed wheels cannot quit each other, being kept together by the link, the inner half (that is, the half next the cylinder) of the wheel U will work on the inner half of the wheel W, ſo that at the end of the revolution of the fly the wheel W muſt have got to the top of the wheel U, and the outer end of the beam muſt be raiſed to its higheſt poſition. The next revolution of the fly will bring the wheel W and the beam connected with it to their firſt poſitions; and thus every two revolutions of the fly will make a complete period of the beam's reciprocating movements. Now, inſtead of ſuppoſing the fly to drive the beam, let the beam drive the fly. The motions muſt be perfectly the ſame, and the aſcent or deſcent of the piſton will produce one revolution of the fly.

A ſide view of this apparatus is given in fig 12. marked by the ſame letters of reference. This ſhows the ſituation of parts which were fore-ſhortened in fig. 11. particularly the deſcending branch C of the ſteam pipe, and the ſituation and communications of the two pumps K and I. 8, 8 is the horizontal part of the ſteam pipe. 9 is a part of it whoſe box is repreſented by the dark circle of fig. 11. D is the box of the ſteam clack, and the little circle at its corner repreſents the end of the axis which turns it, as will be deſcribed afterwards. N is the place of the upper eduction valve. A part only of the upper eduction-pipe G is repreſented, the reſt being cut off, becauſe it would have covered the deſcending ſteam pipe CC. When continued down, it comes between the eye and the box E of the lower ſteam valve, and the box F of the lower eduction valve.

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Let us now trace the operation of this machine through all its ſteps. Recurring to fig. 11. let us ſuppoſe that the lower part of the cylinder BB is exhauſted of all elaſtic fluids; that the upper ſteam valve D and the lower eduction valve F are open, and that the lower ſteam valve E and upper eduction valve N are ſhut. It is evident that the piſton muſt be preſſed toward the bottom of the cylinder, and muſt pull down the end of the working beam by means of the toothed rack OO and ſector QQ, cauſing the other end of the beam to urge forward the machinery with which it is connected. When the piſton arrives at the bottom of the cylinder, the valves D and F are ſhut by the plug frame, and E and N are opened. By this laſt paſſage the ſteam gets into the eduction-pipe, where it meets with the injection water, and is rapidly condenſed. The ſteam from the boiler enters at the ſame time by E, and preſſing on the lower ſide of the piſton, forces it upwards, and by means of the toothed rack OO and toothed ſector QQ forces up that end of the working beam, and cauſes the other end to urge forward the machinery with which it is connected: and in this manner the operation of the engine may be continued for ever.

The injection water is continually running into the eduction-pipe, becauſe condenſation is continually going on, and therefore there is a continual atmoſpheric preſſure to produce a jet. The air which is diſengaged from the water, or enters by leaks, is evacuated only during the riſe of the piſton of the air-pump K. When this is very copious, it renders a very large air-pump neceſſary; and in ſome ſituations Mr Watt has been obliged to employ two air-pumps, one worked by each arm of the beam. This in every caſe expends a very conſiderable portion of the power, for the air-pump is always working againſt the whole preſſure of the atmoſphere.

It is evident that this form of the engine, by maintaining an almoſt conſtant and uninterrupted impulſion, is much fitter for driving any machinery of continued motion than any of the former engines, which were inactive during half of their motion. It does not, however, ſeem to have this ſuperiority when employed to draw water: But it is equally fitted for this taſk. Let the engine be loaded with twice as much as would be proper for it if a ſingle ſtroke engine, and let a fly be connected with it. Then it is plain that the power of the engine during the riſe of the ſteam piſton will be accumulated in the fly; and this, in conjunction with the power of the engine during the deſcent of the ſteam piſton, will be equal to the whole load of water.

In ſpeaking of the ſteam and eduction valves, we ſaid that they were all puppet valves. Mr Watt employed cocks, and alſo ſliding valves, ſuch as the regulator or ſteam-valve, in the old engines. But he found them always loſe their tightneſs after a ſhort time. This is not ſurpriſing, when we conſider that they are always perfectly dry, and almoſt burning hot. He was therefore obliged to change them all for puppet clacks, which, when truly ground and nicely fitted in their motions at firſt, are not found to go out of order by any length of time. Other engineers now univerſally uſe them in the old form of the ſteam-engine, without the ſame reaſons, and merely by ſervile and ignorant imitation.

The way in which Mr Watt opens and ſhuts theſe valves is as follows. Fig. 13. repreſents a clack with its

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its ſeat and box. Suppoſe it one of the eduction valves. HH is part of the pipe which introduces the ſteam, and GG is the upper part of the pipe which communicates with the condenſer. At EE may be obſerved a piece more faintly ſhaded than the ſurrounding parts. This is the ſeat of the valve, and is a braſs or bell-metal ring turned conical on the outſide, ſo as to fit exactly into a conical part of the pipe GG. Theſe two pieces are fitted by grinding; and the cone being of a long taper, the ring ſticks firmly in it, eſpecially after having been there for ſome time and united by ruſt. The clack itſelf is a ſtrong braſs plate D, turned conical on the edge, ſo as to fit the conical or ſloping inner edge of the ſeat. Theſe are very nicely ground on each other with emery. This conical joining is much more obtuſe than the outer ſide of the ring; ſo that although the joint is air-tight, the two pieces do not ſtick ſtrongly together. The clack has a round tail DG, which is freely moveable up and down in the hole of a croſs piece FF. On the upper ſide of the valve is a ſtrong piece of metal DC firmly joined to it, one ſide of which is formed into a toothed rack. A is the ſection of an iron axle which turns in holes in the oppoſite ſides of the valve-box, where it is nicely fitted by grinding, ſo as to be air-tight. Collets of thick leather, well ſoaked in melted tallow and roſin, are ſcrewed on the outſide of theſe holes to prevent all ingreſs of air. One end of this axis projects a good way without the box, and carries a ſpanner or handle, which is moved by the plug-frame. To this axis is fixed a ſtrong piece of metal B, the edge of which is formed into an arch of a circle having the axis A in its centre, and is cut into teeth, which work in the teeth of the rack DC. K is a cover which is fixed by ſcrews to the top of the box HJJH, and may be taken off in order to get at the valve when it needs repairs.

From this deſcription it is eaſy to ſee that by turning the handle which is on the axis A, the ſector B muſt lift up the valve by means of its toothed rack DC, till the upper end of the rack touch the knob or button K. Turning the handle in the oppoſite direction brings the valve down again to its ſeat.

This valve is extremely tight. But in order to open it for the paſſage of the ſteam, we muſt exert a force equal to the preſſure of the atmoſphere. This in a large engine is a very great weight. A valve of ſix inches diameter ſuſtains a preſſure not leſs than 400 pounds. But this force is quite momentary, and hardly impedes the motion of the engine; for the inſtant the valve is detached from its ſeat, although it has not moved the 100th part of an inch, the preſſure is over. Even this little inconvenience has been removed by a delicate thought of Mr Watt. He has put the ſpanner in ſuch a poſition when it *begins* to raiſe the valve, that its mechanical energy is almoſt infinitely great. Let QR (fig. 14.) be part of the plug-frame deſcending, and P one of its pins juſt going to lay hold of the ſpanner NO moveable round the axis N. On the ſame axis is another arm NM connected by a joint with the leader ML, which is connected alſo by a joint with the ſpanner LA that is on the axis A of the ſector within the valve-box. Therefore when the pin P puſhes down the ſpanner NO, the arm NM moves ſidewiſe and pulls down the ſpanner AL by means of the connecting rod. Things are ſo diſpoſed, that when the cock is ſhut, LM and MN are in one ſtraight line. The intelligent mechanic will perceive that, in this poſition, the force of the lever ONM is inſuperable. It has this further advantage, that if any thing ſhould tend to force open the valve, it would be ineffectual; for no force exerted at A, and tranſmitted by the rod LM, can poſſibly puſh the joint M out of its poſition. Of ſuch importance is it to practical mechanics, that its profeſſors ſhould be perſons of penetration as well as knowledge. Yet this circumſtance is unheeded by hundreds who have ſervilely copied from Mr Watt, as may be ſeen in every engine that is puffed on the public as a diſcovery and an improvement. When theſe puppet valves have been introduced into the common engine, we have not ſeen one inſtance where this has been attended to; certainly becauſe its utility has not been obſerved: and there is one ſituation where it is of more conſequence than in Mr Watt's engine, viz. in the injection-cock. Here the valve is drawn back into a box, where the water is ſo aukwardly diſpoſed round it that it can hardly get out of its way, and where the preſſure even exceeds that of the atmoſphere. Indeed this particular ſubſtitution of the button-valve for the cock is moſt injudicious.

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We poſtponed any account of the office of the fly XX (fig. 11.), as it is not of uſe in an engine regulated by the fly VV. The fly XX is only for regulating the reciprocating motion of the beam when the ſteam is not admitted during the whole deſcent of the piſton. This it evidently muſt render more uniform, accumulating a momentum equal to the whole preſſure of the full ſupply of ſteam, and then ſharing it with the beam during the reſt of the deſcent of the piſton.

72 Review of Mr Watt's three great improvements.

When a perſon properly ſkilled in mechanics and chemiſtry reviews theſe different forms of Mr Watt's ſteam-engine, he will eaſily perceive them ſuſceptible of many intermediate forms, in which any one or more of the diſtinguiſhing improvements may be employed. The firſt great improvement was the condenſation in a ſeparate veſſel. This increaſed the original powers of the engine, giving to the atmoſpheric preſſure and to the counter weight their full energy; at the ſame time the waſte of ſteam is greatly diminiſhed. The next improvement by employing the preſſure of the ſteam inſtead of that of the atmoſphere, aimed only at a ſtill farther diminution of the waſte; but was fertile in advantages, rendering the machine more manageable, and particularly enabling us at all times, and without trouble, to ſuit the power of the engine to its load of work, however variable and increaſing; and brought into view a very intereſting propoſition in the mechanical theory of the engine, viz. that the whole performance of a given quantity of ſteam may be augmented by admitting it into the cylinder only during a part of the piſton's motion. Mr Watt has varied the application of this propoſition in a thouſand ways; and there is nothing about the machine which gives more employment to the ſagacity and judgment of the engineer. The third improvement of the double impulſe may be conſidered as the finiſhing touch given to the engine, and renders it as uniform in its action as any water-wheel. In the engine in its moſt perfect form there does not ſeem to be above one-fourth of the ſteam waſted by warming the apparatus; ſo that *it is not poſſible* to make it one-fourth part more powerful than it is at preſent. The only thing that ſeems ſuſceptible of conſiderable improvement

Fig. 2.

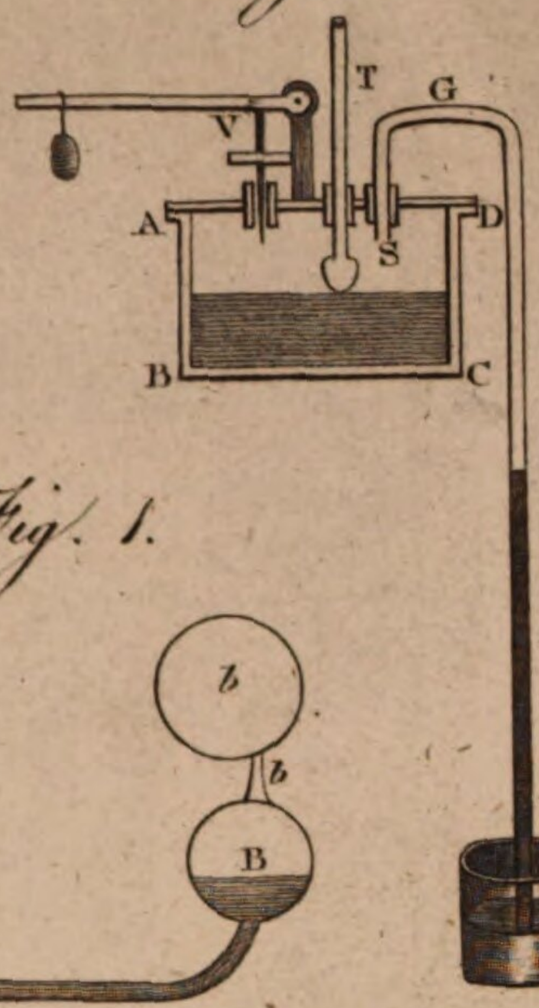


Fig. 1.

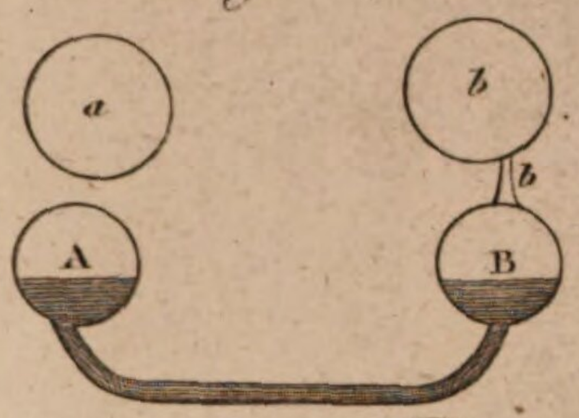


Fig. 6.

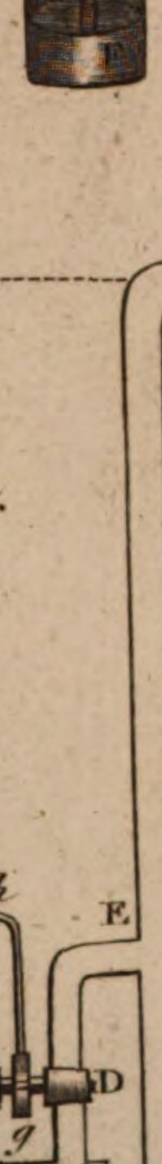
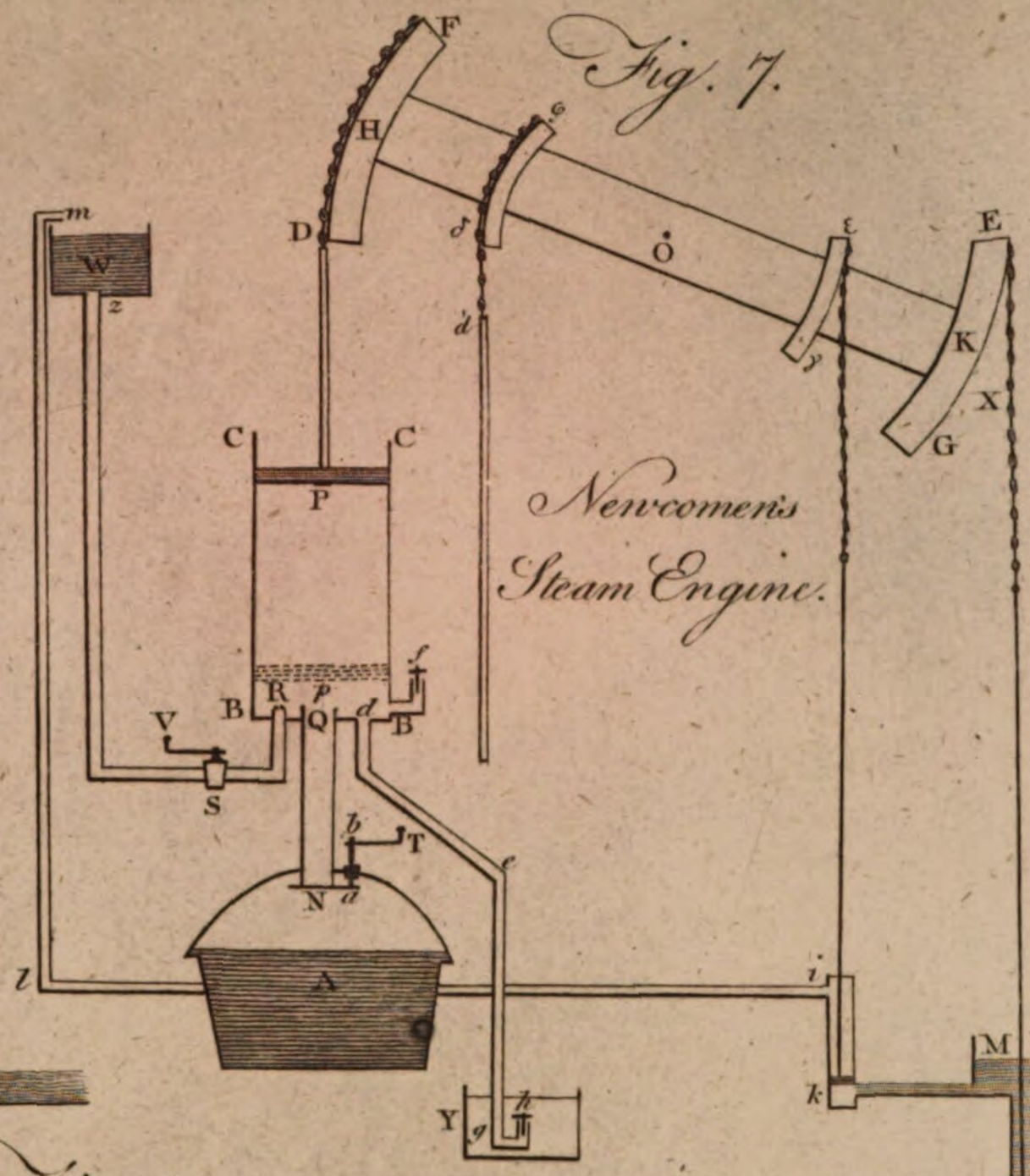


Fig. 7.



Savary's
Steam Engine.

Fig. 3.

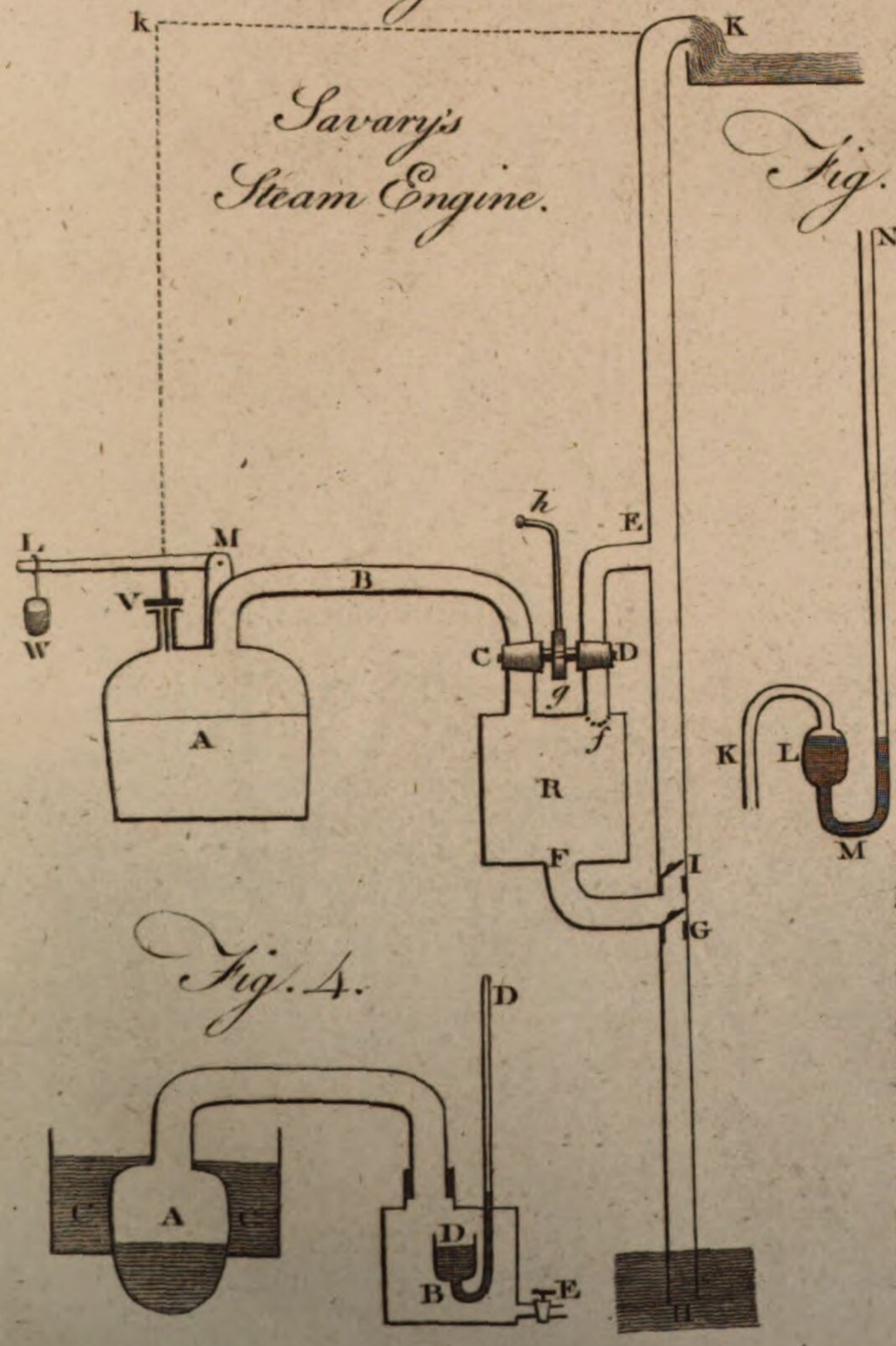


Fig. 5.

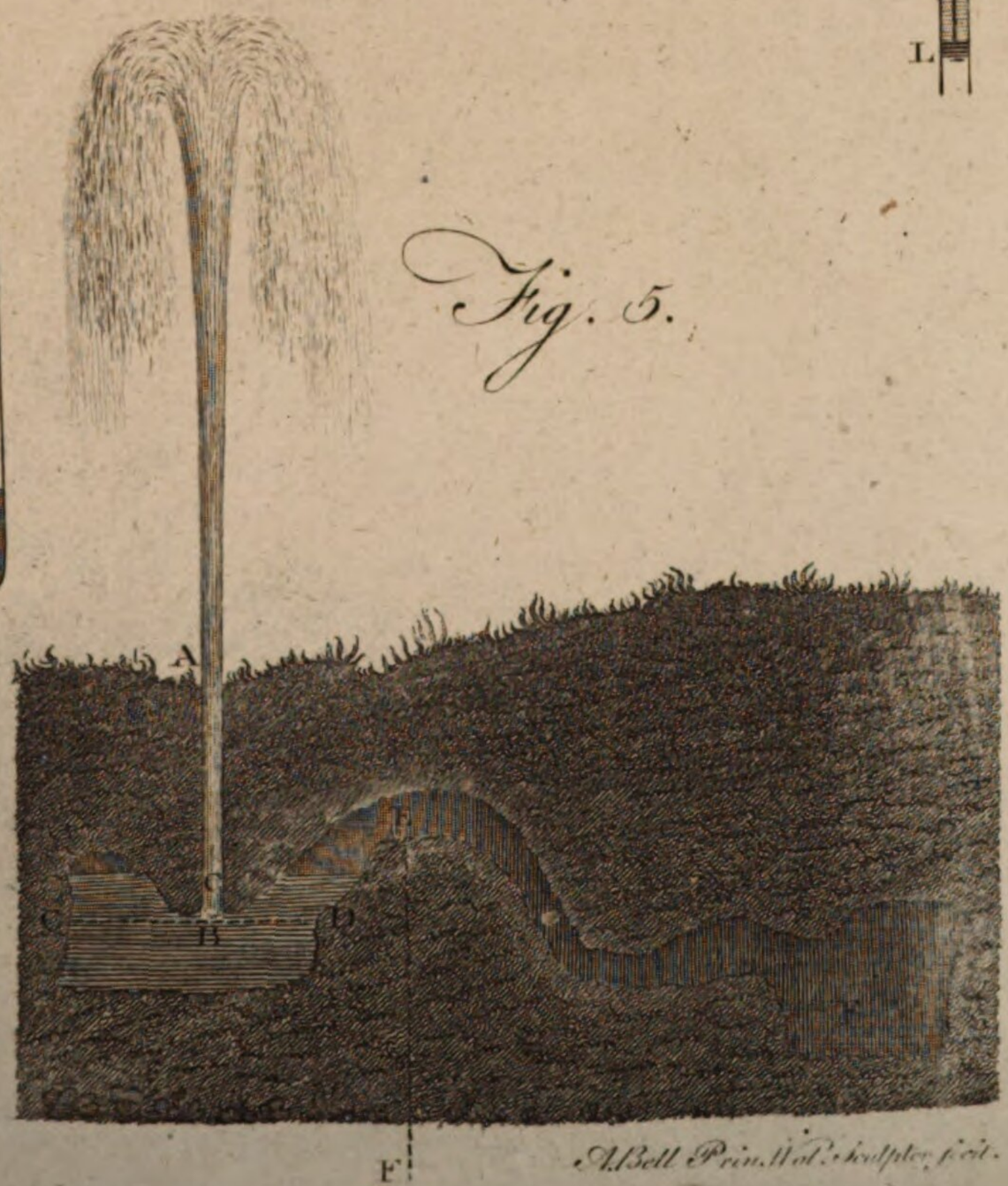
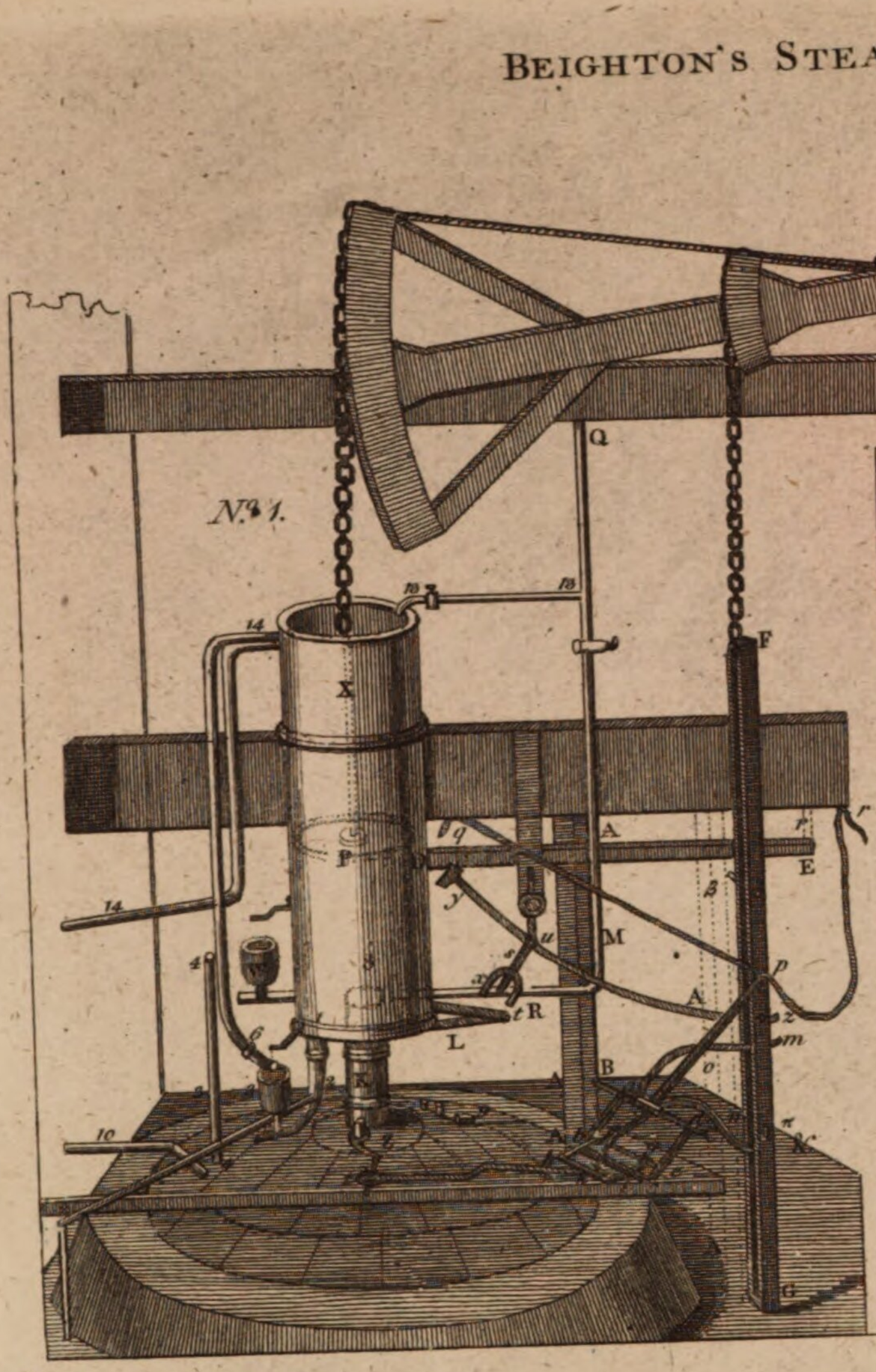


Fig. 4.

A. Bell Prin. Mod. Sculptor. fecit.

Plate CCCCLXXVIII.

BEIGHTON'S STEAM ENGINE.



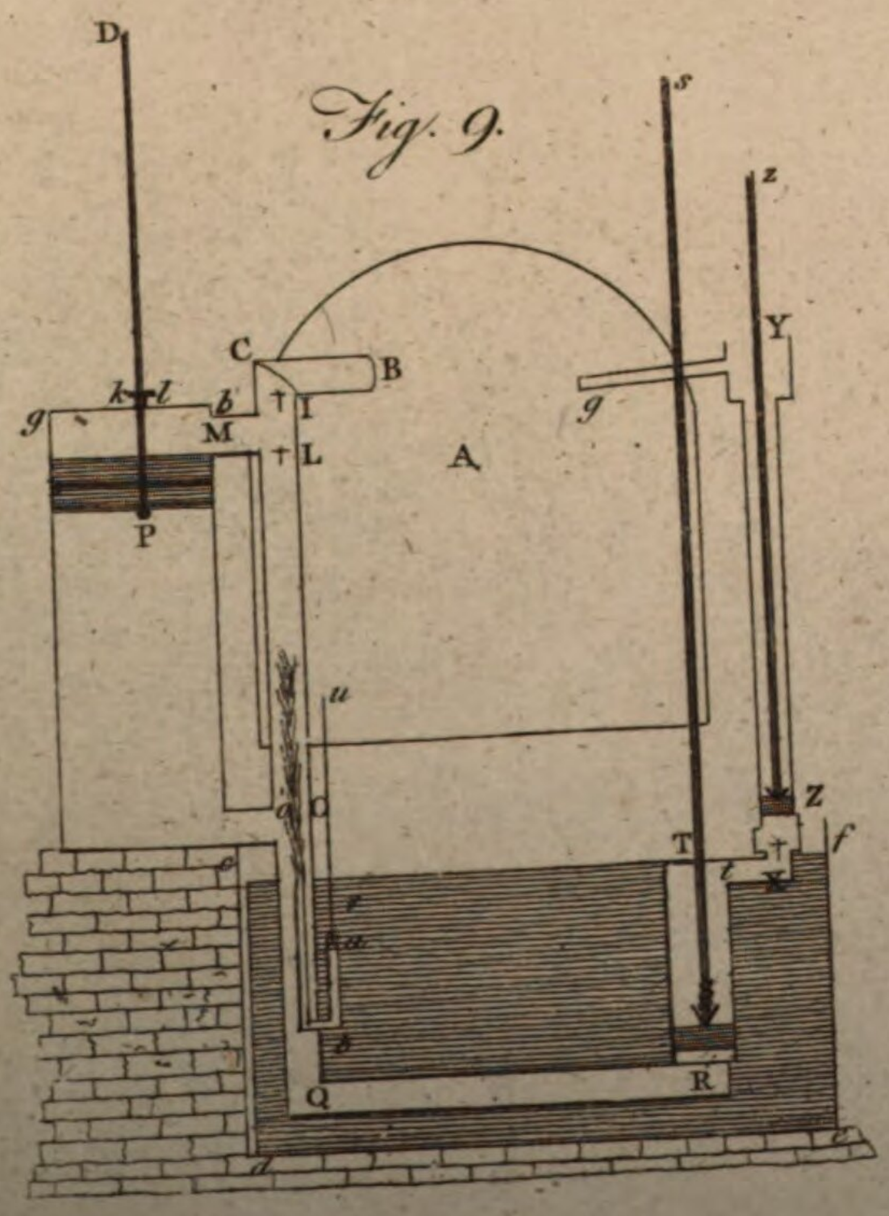


Fig. 9.

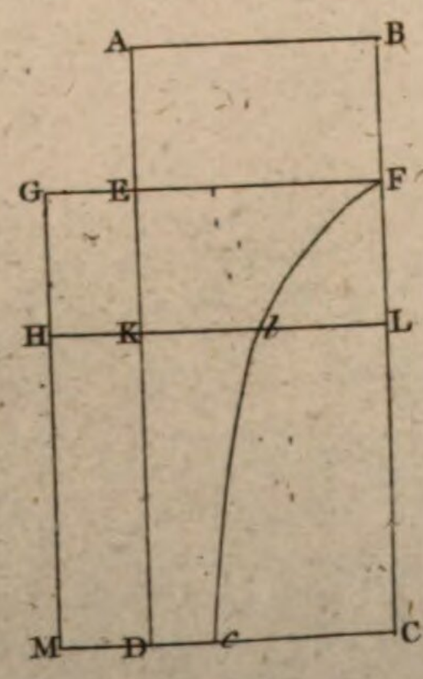


Fig. 10.

A. Bell. Pein. Wal. Sculptor.

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is the great beam. The enormous ſtrains exerted on its arms require a proportional ſtrength. This requires a vaſt maſs of matter, not leſs indeed in an engine with a cylinder of 54 inches than three tons and a half, moving with the velocity of three feet in a ſecond, which muſt be communicated in about half a ſecond. This maſs muſt be brought into motion from a ſtate of reſt, muſt again be brought to reſt, again into motion, and again to reſt, to complete the period of a ſtroke. This conſumes much power; and Mr Watt has not been able to load an engine with more than 10 or 11 pounds on the inch and preſerve a ſufficient quantity of motion, ſo as to make 12 or 15 ſix-feet ſtrokes in a ſecond. Many attempts have been made to leſſen this maſs by uſing a light framed wheel, or a light frame of carpentry, in place of a ſolid beam. Theſe have generally been conſtructed by perſons ignorant of the true ſcientific principles of carpentry, and have fared accordingly. Mr Watt has made ſimilar attempts; but found, that although at firſt they were abundantly ſtrong, yet after a ſhort time's employment the ſtraps and bolts with which the wooden parts were connected cut their way into the wood, and the framing grew looſe in the joints, and, without giving any warning, went to pieces in an inſtant. A ſolid maſſy ſimple beam, of ſufficient ſtrength, bends, and ſenſibly complains (as the carpenters expreſs it), before it breaks. In all great engines, therefore, ſuch only are employed, and in ſmaller engines he ſometimes uſes caſt-iron wheels or pulleys; nay, he frequently uſes no beam or equivalent whatever, but employs the ſteam piſton-rod to drive the machinery to which the engine is applied.

73 The only improvement now wanting is to ſtrengthen the great beam.

74 Mr Watt aſſociated with Mr Boulton.

We preſume that our thinking readers will not be diſpleaſed with this rational hiſtory of the progreſs of this engine in the hands of its ingenious and worthy inventor. We owe it to the communications of a friend, well acquainted with him, and able to judge of his merits. The public ſee him always aſſociated with the no leſs celebrated mechanic and philoſopher Mr Boulton of Soho near Birmingham (ſee SOHO). They have ſhared the royal patent from the beginning; and the alliance is equally honourable to both.

75 Whence their profits are derived in erecting engines.

The advantages derived from the patent-right ſhow both the ſuperiority of the engine and the liberal minds of the proprietors. They erect the engines at the expence of the employers, or give working draſts of all the parts, with inſtructions, by which any reſident engineer may execute the work. The employers ſelect the beſt engine of the ordinary kind in the kingdom, compare the quantities of fuel expended by each, and pay to Meſſrs Watt and Boulton one-third of the annual ſavings for a certain term of years. By this the patentees are excited to do their utmoſt to make the engine perfect; and the employer pays in proportion to the advantage he derives from it.

It may not be here improper to ſtate the actual performance of ſome of theſe engines, as they have been aſcertained by experiment.

76 What the actual performance of ſome of theſe engines is.

An engine having a cylinder of 31 inches in diameter, and making 17 double ſtrokes per minute, performs the work of forty horſes working night and day (for which three relays or 120 horſes muſt be kept), and burns 11,000 pounds of Staffordſhire coal *per* day. A cylinder of 19 inches, making 25 ſtrokes of 4 feet each per minute, performs the work of 12 horſes working conſtantly, and burns 3700 pounds of coals *per* day. A cylinder of 24 inches, making 22 ſtrokes of 5 feet, burns 5500 pounds of coals, and is equivalent to the conſtant work of 20 horſes. And the patentees think themſelves authorized by experience to ſay in general, that theſe engines will raiſe more than 20,000 cubic feet of water 24 feet high for every hundred weight of good pit-coal conſumed by them.

Steam-Engine.

In conſequence of the great ſuperiority of Mr Watt's engines, both with reſpect to economy and manageableneſs, they have become of moſt extenſive uſe; and in every demand of manufacture on a great ſcale they offer us an indefatigable ſervant, whoſe ſtrength has no bounds. The greateſt mechanical project that ever engaged the attention of man was on the point of being executed by this machine. The States of Holland were treating with Meſſrs Watt and Boulton for draining the Haerlem Meer, and even reducing the Zuyder Zee: and we doubt not but that it will be accompliſhed whenever that unhappy nation has ſufficiently felt the difference between liberty and democratic tyranny. Indeed ſuch unlimited powers are afforded by this engine, that the engineer now thinks that no taſk can be propoſed to him which he cannot execute with profit to his employer.

77 Propoſed to drain the Haerlem Meer by the ſteam-engine.

78 The attempts to improve Mr Watt's engine in general of little advantage;

No wonder then that all claſſes of engineers have turned much of their attention to this engine; and ſeeing that it has done ſo much, that they try to make it do ſtill more. Numberleſs attempts have been made to improve Mr Watt's engine; and it would occupy a volume to give an account of them, whilſt that account would do no more than indulge curioſity. Our engineers by profeſſion are in general miſerably deficient in that accurate knowledge of mechanics and of chemiſtry which is neceſſary for underſtanding this machine; and we have not heard of one in this kingdom who can be put on a par with the preſent patentees in this reſpect. Moſt of the attempts of engineers have been made with the humbler view of availing themſelves of Mr Watt's diſcoveries, ſo as to conſtruct a ſteam-engine ſuperior to Newcomen's, and yet of a form ſufficiently different from Watt's to keep it without the reach of his patent. This they have in general accompliſhed by performing the condenſation in a place which, with a little ſtretch of fancy, not unfrequent in a court of law, may be called *part of the cylinder*.

79 And the ſucceſs of theſe has not injured the other.

The ſucceſs of moſt of theſe attempts has interfered ſo little with the intereſt of the patentees, that they have not hindered the erection of many engines which the law would have deemed encroachments. We think it our duty to give our opinion on this ſubject without reſerve. Theſe are moſt expenſive undertakings, and few employers are able to judge accurately of the merits of a project preſented to them by an ingenious artiſt. They may ſee the practicability of the ſcheme, by having a general notion of the expanſion and condenſation of ſteam, and they may be miſled by the ingenuity apparent in the conſtruction. The engineer himſelf is frequently the dupe of his own ingenuity; and it is not always diſhoneſty, but frequently ignorance, which makes him prefer his own invention or (as he thinks it) improvement. It is a moſt delicate engine, and requires much knowledge to ſee what does and what does not improve its performance. We have gone into the preceding minute inveſtigation of Mr Watt's progreſs with the expreſs purpoſe of making our readers fully maſters of

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of its principles, and have more than once pointed out the real improvements, that they may be firmly fixed and always ready in the mind. By having recourſe to them, the reader may pronounce with confidence on the merits of any new conſtruction, and will not be deceived by the puffs of an ignorant or diſhoneſt engineer.

80 Exception in favour of Mr Hornblower.

We muſt except from this general criticiſm a conſtruction by Mr Jonathan Hornblower near Briſtol, on account of its ſingularity, and the ingenuity and real ſkill which appears in ſome particulars of its conſtruction. The following ſhort deſcription will ſufficiently explain its principle, and enable our readers to appreciate its merit.

Plate ccccLxxx. 81 Deſcription of his ſteam-engine.

A and B (fig. 15.) repreſent two cylinders, of which A is the largeſt. A piſton moves in each, having their rods C and D moving through collars at E and F. Theſe cylinders may be ſupplied with ſteam from the boiler by means of the ſquare pipe G, which has a flanch to connect it with the reſt of the ſteam pipe. This ſquare part is repreſented as branching off to both cylinders. *c* and *d* are two cocks, which have handles and tumblers as uſual, worked by the plug-beam W. On the fore-ſide (that is, the ſide next the eye) of the cylinders is repreſented another communicating pipe, whoſe ſection is alſo ſquare or rectangular, having alſo two cocks *a*, *b*. The pipe Y, immediately under the cock *b*, eſtabliſhes a communication between the upper and lower parts of the ſmall cylinder B, by opening the cock *b*. There is a ſimilar pipe on the other ſide of the cylinder A, immediately under the cock *d*. When the cocks *c* and *a* are open, and the cocks *b* and *d* are ſhut, the ſteam from the boiler has free admiſſion into the upper part of the cylinder B, and the ſteam from the lower part of B has free admiſſion into the upper part of A; but the upper part of each cylinder has no communication with its lower part.

From the bottom of the great cylinder proceeds the eduction-pipe K, having a valve at its opening into the cylinder, which bends downwards, and is connected with the conical condenſer L (c). The condenſer is fixed on a hollow box M, on which ſtand the pumps N and O for extracting the air and water; which laſt runs along the trough T into a ciſtern U, from which it is raiſed by the pump V for recruiting the boiler, being already nearly boiling hot. Immediately under the condenſer there is a ſpigot valve at S, over which is a ſmall jet pipe, reaching to the bend of the eduction-pipe. The whole of the condenſing apparatus is contained in a ciſtern R of cold water. A ſmall pipe P comes from the ſide of the condenſer, and terminates on the bottom of the trough T, and is there covered with a valve Q, which is kept tight by the water that is always running over it. Laſtly, the pump-rods X cauſe the outer end of the beam to preponderate, ſo that the quieſcent poſition of the beam is that repreſented in the figure, the piſtons being at the top of the cylinders.

Suppoſe all the cocks open, and ſteam coming in copiouſly from the boiler, and no condenſation going on in L; the ſteam muſt drive out all the air, and at laſt follow it through the valve Q. Now ſhut the valves *b* and *d*, and open the valve S of the condenſer. The condenſation will immediately commence. There is now no preſſure on the under ſide of the piſton of A, and it immediately deſcends. The communication between the lower part of B and the upper part of A being open, the ſteam will go from B into the ſpace left by the piſton of A. It muſt therefore expand, and its elaſticity muſt diminiſh, and will no longer balance the preſſure of the ſteam above the piſton of B. This piſton therefore, if not with-held by the beam, would deſcend till it is in equilibrio, having ſteam of equal denſity above and below it. But it cannot deſcend ſo far; for the cylinder A is wider than B, and the arm of the beam at which its piſton hangs is longer than the arm which ſupports the piſton of B: therefore when the piſton of B has deſcended as far as the beam will permit it, the ſteam between the two piſtons occupies a larger ſpace than it did when both piſtons were at the tops of their cylinders. Its denſity, therefore, and its elaſticity, diminiſh as its bulk increaſes. It is therefore not a balance; for the ſteam on the upper ſide of B, and the piſton B, *pulls* at the beam with all the difference of theſe preſſures. The ſlighteſt view of the ſubject muſt ſhow the reader, that as the piſtons deſcend, the ſteam that is between them will grow continually rarer and leſs elaſtic, and that both piſtons will pull the beam downwards.

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Suppoſe now that each has reached the bottom of its cylinder. Shut the cock *a* and the eduction cock at the bottom of A, and open the cocks *b* and *d*. The communication being now eſtabliſhed between the upper and lower part of each cylinder, nothing hinders the counter weight from raiſing the piſtons to the top. Let them arrive there. The cylinder B is at this time filled with ſteam of the ordinary denſity, and the cylinder A with an equal abſolute quantity of ſteam, but expanded into a larger ſpace.

Shut the cocks *b* and *d*, and open the cock *a*, and the eduction cock at the bottom of A; the condenſation will again operate, and the piſtons deſcend. And thus the operation may be repeated as long as ſteam is ſupplied; and one full of the cylinder B of ordinary ſteam is expended during each working ſtroke.

Let us now examine the power of this engine. It is evident, that when both piſtons are at the top of their reſpective cylinders, the active preſſure (that is, the difference of the preſſure on its two ſides) on the piſton of B is nothing, while that on the piſton of A is equal to the full preſſure of the atmoſphere on its area. This, multiplied by the length of the arm by which it is ſupported, gives its mechanical energy. As the piſtons deſcend, the preſſure on the piſton of B increaſes, while that on the piſton of A diminiſhes. When both are at the bottom, the preſſure on the piſton of B is at its maximum, and that on the piſton of A at its minimum.

Mr Hornblower ſaw that this muſt be a beneficial employment of ſteam, and preferable to the practice of condenſing it while its full elaſticity remained; but he has not conſidered it with the attention neceſſary for aſcertaining the advantage with preciſion.

Let *a* and *b* repreſent the areas of the piſtons of A and

(c) This, however, was ſtopped by Watt's patent; and the condenſation muſt be performed as in Newcomen's engine, or at leaſt in the cylinder A.

Steam-Engine.

and B, and let α and β be the lengths of the arms by which they are ſupported. It is evident, that when both piſtons have arrived at the bottoms of their cylinders, the capacities of the cylinders are as $a\alpha$ and $b\beta$. Let this be the ratio of m to 1. Let $g\,h\,i\,k$ (fig. 16.) and $l\,m\,n\,o$ be two cylinders of equal length, communicating with each other, and fitted with a piſton-rod $p\,q$, on which are fixed two piſtons $a\,a$ and $b\,b$, whoſe areas are as m and 1. Let the diſtance between the piſtons be preciſely equal to the height of each cylinder, which height we ſhall call h. Let x be the ſpace $g\,b$ or $b\,a$, through which the piſtons have deſcended. Let the upper cylinder communicate with the boiler, and the lower cylinder with the condenſer or vacuum V.

Any perſon in the leaſt converſant in mechanics and pneumatics will clearly ſee that the ſtrain or preſſure on the piſton rod $p\,q$ is preciſely the ſame with the united energies of the two piſton rods of Mr Hornblower's engine, by which they tend to turn the working beam round its axis.

The baſe of the upper cylinder being 1, and its height h, its capacity or bulk is $1\,h$ or h; and this expreſſes the natural bulk of the ſteam which formerly filled it, and is now expanded into the ſpace $b\,b\,l\,a\,a\,m\,i\,b$. The part $b\,b\,i\,b$ is plainly $= h - x$, and the part $l\,a\,a\,m$ is $= m\,x$. The whole ſpace therefore is $m\,x + h - x$, $= h + m\,x - x$, or $h + \overline{m-1}\,x$. Therefore the denſity of the ſteam between the piſtons is $\frac{h}{h + \overline{m-1}\,x}$.

Let p be the downward preſſure of the ſteam from the boiler on the upper piſton $b\,b$. This piſton is alſo preſſed up with a force $= p\frac{h}{h + \overline{m-1}\,x}$ by the ſteam between the piſtons. It is therefore, on the whole, preſſed downward with a force $= p\left(1 - \frac{h}{h + \overline{m-1}\,x}\right)$. The lower piſton $a\,a$, having a vacuum below it, is preſſed downwards with a force $= p\frac{mh}{h + \overline{m-1}\,x}$. Therefore the whole preſſure on the piſton rod downwards is $= p\left(1 + \frac{mh}{h + \overline{m-1}\,x} - \frac{h}{h + \overline{m-1}\,x}\right)$, $= p\left(1 + \frac{\overline{m-1}\,h}{h + \overline{m-1}\,x}\right)$, $= p + \frac{p\,h\,\overline{m-1}}{h + \overline{m-1}\,x} = p + \frac{p\,h}{\frac{h}{\overline{m-1}} + x}$.

This then is the momentary preſſure on the piſton rod correſponding to its deſcent x from its higheſt poſition. When the piſtons are in their higheſt poſition, this preſſure is equal to $m\,p$. When they are in their loweſt poſition, it is $= p\frac{2m-1}{m}$. Here therefore is an acceſſion of power. In the beginning the preſſure is greater than on a ſingle piſton in the proportion of m to 1; and at the end of the ſtroke, where the preſſure is weakeſt, it is ſtill much greater than the preſſure on a ſingle piſton. Thus, if m be 4, the preſſure at the beginning of the ſtroke is $4p$, and at the end it is $\frac{7}{4}p$, almoſt double, and in all intermediate poſitions it is greater. It is worth while to obtain the ſum total of all the accumulated preſſures, that we may compare it with the conſtant preſſure on a ſingle piſton.

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We may do this by conſidering the momentary preſſure $p + \frac{p\,h}{\frac{h}{\overline{m-1}} + x}$, as equal to the ordinate GF, H b, or M c, of a curve F $b\,c$ (fig. 10.), which has for its axis the line GM equal to h the height of our cylinder. Call this ordinate y. We have $y = p + \frac{p\,h}{\frac{h}{\overline{m-1}}\,x}$, and $y - p = \frac{p\,h}{\frac{h}{\overline{m-1}} + x}$. Now it is plain that $\frac{p\,h}{\frac{h}{\overline{m-1}} + x}$ is the ordinate of an equilateral hyperbola, of which $p\,h$ is the power or rectangle of the ordinate and abſciſs, and of which the abſciſs reckoned from the centre is $\frac{h}{\overline{m-1}} + x$. Therefore make GE $= p$, and draw DEA parallel to MG, and make EA $= \frac{GM}{\overline{m-1}}$, $= \frac{h}{\overline{m-1}}$. The curve F $b\,c$ is an equilateral hyperbola, having A for its centre and AD for its aſſymptote. Draw the other aſſymptote AB, and its ordinate FB. Since the power of the hyperbola is $= p\,h$, $=$ GEDM (for GE $= p$, and GM $= h$); and ſince all the inſcribed rectangles, ſuch as AEFB, are equal to $p\,h$, it follows that AEFB is equal to GEDM, and that the area ABFcDA is equal to the area GFcMG, which expreſſes the accumulated preſſure in Hornblower's engine.

We can now compute the accumulated preſſure very eaſily. It is evidently $= p\,h \times \left(1 + \text{L.}\frac{AD}{AE}\right)$.

82 The accumulated preſſure the ſame with that of Mr Watt's engine.

The intelligent reader cannot but obſerve that this is preciſely the ſame with the accumulated preſſure of a quantity of ſteam admitted in the beginning, and ſtopped in Mr Watt's method, when the piſton has deſcended through the mth part of the cylinder. In conſidering Mr Hornblower's engine, the thing was preſented in ſo different a form that we did not perceive the analogy at firſt, and we were ſurpriſed at the reſult. We could not help even regretting it, becauſe it had the appearance of a new principle and an improvement: and we doubt not but that it appeared ſo to the ingenious author; for we have had ſuch proofs of his liberality of mind as permit us not to ſuppoſe that he ſaw it from the beginning, and availed himſelf of the difficulty of tracing the analogy. And as the thing may miſlead others in the ſame way, we have done a ſervice to the public by ſhowing that this engine, ſo coſtly and ſo difficult in its conſtruction, is no way ſuperior in power to Mr Watt's ſimple method of ſtopping the ſteam. It is even inferior, becauſe there muſt be a condenſation in the communicating paſſages. We may add, that if the condenſation is performed in the cylinder A, which it muſt be unleſs with the permiſſion of Watt and Boulton, the engine cannot be much ſuperior to a common engine; for much of the ſteam from below B will be condenſed between the piſtons by the coldneſs of the cylinder A; and this diminiſhes the

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downward preſſure on A more than it increaſes the downward preſſure on B. We learn however that, by confining the condenſation to a ſmall *part of the cylinder* A, Mr Hornblower has erected engines clear of Mr Watt's patent, which are conſiderably ſuperior to Newcomen's: ſo has Mr Symington.

83 Still, however, the engine diſcovers ingenuity and ſkill.

We ſaid that there was much ingenuity and real ſkill obſervable in many particulars of this engine. The diſpoſition and connection of the cylinders, and the whole condenſing apparatus, are contrived with peculiar neatneſs. The cocks are very ingenious; they are compoſed of two flat circular plates ground very true to each other, and one of them turns round on a pin through their centres; each is pierced with three ſectoral apertures, exactly correſponding with each other, and occupying a little leſs than one half of their ſurfaces. By turning the moveable plate ſo that the apertures coincide, a large paſſage is opened for the ſteam; and by turning it ſo that the ſolid of the one covers the aperture of the other, the cock is ſhut. Such regulators are now very common in the caſt iron ſtoves for warming rooms.

Mr Hornblower's contrivance for making the collars for the piſton rods air-tight is alſo uncommonly ingenious. This collar is in fact two, at a ſmall diſtance from each other. A ſmall pipe, branching off from the main ſteam-pipe, communicates with the ſpace between the collars. This ſteam, being a little ſtronger than the preſſure of the atmoſphere, effectually hinders the air from penetrating by the upper collar; and though a little ſteam ſhould get through the lower collar into the cylinder A, it can do no harm. We ſee many caſes in which this pretty contrivance may be of ſignal ſervice.

84 The greateſt improvement is the framing of the working beam.

But it is in the framing of the great working beam that Mr Hornblower's ſcientific knowledge is moſt conſpicuous; and we have no heſitation in affirming that it is ſtronger than a beam of the common form, and containing twenty times its quantity of timber. There is hardly a part of it expoſed to a tranſverſe ſtrain, if we except the ſtrain of the pump V on the ſtrutt by which it is worked. Every piece is either puſhed or pulled in the direction of its length. We only fear that the bolts which connect the upper beam with the two iron bars under its ends will work looſe in their holes, and tear out the wood which lies between them. We would propoſe to ſubſtitute an iron bar for the whole of this upper beam. This working beam highly deſerves the attention of all carpenters and engineers. We have that opinion of Mr Hornblower's knowledge and talents, that we are confident that he will ſee the fairneſs of our examination of his engine, and we truſt to his candour for an excuſe for our criticiſm.

85 The reciprocating motion of the ſteam-engine is a defect ſtill to be remedied.

The reciprocating motion of the ſteam-engine has always been conſidered as a great defect; for though it be now obviated by connecting it with a fly, yet, unleſs it is an engine of double ſtroke, this fly muſt be an enormous maſs of matter moving with great velocity. Any accident happening to it would produce dreadful effects: A part of the rim detaching itſelf would have the force of a bomb, and no building could withſtand it. Many attempts have been made to produce a circular motion at once by the ſteam. It has been made to blow on the vanes of a wheel of various forms. But the rarity of ſteam is ſuch, that even if none is condenſed by the cold of the vanes, the impulſe is exceedingly feeble, and the expence of ſteam, ſo as to produce any ſerviceable impulſe, is enormous. Mr Watt, among his firſt ſpeculations on the ſteam-engine, made ſome attempts of this kind. One in particular was uncommonly ingenious. It conſiſted of a drum turning air-tight within another, with cavities ſo diſpoſed that there was a conſtant and great preſſure urging it in one direction. But no packing of the common kind could preſerve it air-tight with ſufficient mobility. He ſucceeded by immerſing it in mercury, or in an amalgam which remained fluid in the heat of boiling water; but the continual trituration ſoon calcined the fluid and rendered it uſeleſs. He then tried Parent's or Dr Barker's mill, incloſing the arms in a metal drum, which was immerſed in cold water. The ſteam ruſhed rapidly along the pipe which was the axis, and it was hoped that a great reaction would have been exerted at the ends of the arms; but it was almoſt nothing. The reaſon ſeems to be, that the greateſt part of the ſteam was condenſed in the cold arms. It was then tried in a drum kept boiling-hot; but the impulſe was now very ſmall in compariſon with the expence of ſteam. This muſt be the caſe.

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86 Mr Watt's attempts to produce a circular motion by ſteam unſucceſsful.

Mr Watt has deſcribed in his ſpecification to the patent office ſome contrivances for producing a circular motion by the immediate action of the ſteam. Some of theſe produce alternate motions, and are perfectly analogous to his double ſtroke engine. Others produce a continued motion. But he has not given ſuch a deſcription of his valves for this purpoſe as can enable an engineer to conſtruct one of them. From any gueſs that we can form, we think the machine very imperfect; and we do not find that Mr Watt has ever erected a continuous circular engine. He has doubtleſs found all his attempts inferior to the reciprocating engine with a fly. A very crude ſcheme of this kind may be ſeen in the Tranſactions of the Royal Society of Dublin 1787. But although our attempts have hitherto failed, we hope that the caſe is not yet deſperate: We ſee different principles which have not yet been employed.

87 Still the caſe is not deſperate, for different principles may be employed.

88 Mr Watt's engine ſuggeſts the conſtruction of an excellent air-pump.

We ſhall conclude our account of this noble engine with obſerving, that Mr Watt's form ſuggeſts the conſtruction of an excellent air-pump. A large veſſel may be made to communicate with a boiler at one ſide, and with the pump-receiver on the other, and alſo with a condenſer. Suppoſe this veſſel of ten times the capacity of the receiver: fill it with ſteam from the boiler, and drive out the air from it; then open its communication with the receiver and the condenſer. This will rarefy the air of the receiver 10 times. Repeating the operation will rarefy it 100 times; the third operation will rarefy it 1000 times; the fourth 10,000 times, &c. All this may be done in half a minute.

Steam-Kitchen. Ever ſince Dr Papin contrived his digeſter (about the year 1690), ſchemes have been propoſed for dreſſing victuals by the ſteam of boiling water. A philoſophical club uſed to dine at Saltero's coffee-houſe, Chelſea, about 30 years ago, and had their victuals dreſſed by hanging them in the boiler of the ſteam-engine which raiſes water for the ſupply of Picadilly and its neighbourhood. They were completely dreſſed, and both expeditiouſly and with high flavour.

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A patent was lately obtained for an apparatus for this purpoſe by a tin-man in London; we think of the name of Tate. They are made on a much more effective plan by Gregory, an ingenious tradeſman in Edinburgh, and are coming into very general uſe.

It is well known to the philoſopher that the ſteam of boiling water contains a prodigious quantity of heat, which it retains in a latent ſtate ready to be faithfully accounted for, and communicated to any colder body. Every cook knows the great ſcalding power of ſteam, and is diſpoſed to think that it is much hotter than boiling water. This, however, is a miſtake; for it will raiſe the thermometer no higher than the water from which it comes. But we can aſſure the cook, that if he make the ſteam from the ſpout of a tea-kettle paſs through a great body of cold water, it will be condenſed or changed into water; and when one pound of water has in this manner been boiled off, it will have heated the maſs of cold water as much as if we had thrown into it ſeven or eight hundred pounds of boiling hot water.

If, therefore, a boiler be properly fitted up in a furnace, and if the ſteam of the water boiling in it be conveyed by a pipe into a pan containing victuals to be dreſſed, every thing can be cooked that requires no higher degree of heat than that of boiling water: And this will be done without any riſk of ſcorching, or any kind of overheating, which frequently ſpoils our diſhes, and proceeds from the burning heat of air coming to thoſe parts of the pot or pan which is not filled with liquor, and is covered only with a film, which quickly burns and taints the whole diſh. Nor will the cook be ſcorched by the great heat of the open fire that is neceſſary for dreſſing at once a number of diſhes, nor have his perſon and clothes ſoiled by the ſmoke and ſoot unavoidable in the cooking on an open fire. Indeed the whole proceſs is ſo neat, ſo manageable, ſo open to inſpection, and ſo cleanly, that it need neither fatigue nor offend the delicacy of the niceſt lady.

We had great doubts, when we firſt heard of this as a general mode of cookery, as to its economy; we had none as to its efficacy. We thought that the ſteam, and conſequently the fuel expended, muſt be vaſtly greater than by the immediate uſe of an open fire; but we have ſeen a large tavern dinner expeditiouſly dreſſed in this manner, ſeemingly with much leſs fuel than in the common method. The following ſimple narration of facts will ſhow the ſuperiority. In a paper manufacture in this neighbourhood, the vats containing the pulp into which the frames are dipped are about ſix feet diameter, and contain above 200 gallons. This is brought to a proper heat by means of a ſmall cockle or furnace in the middle of the liquor. This is heated by putting in about one hundred weight of coals about eight o'clock in the evening, and continuing this till four next morning, renewing the fuel as it burns away. This method was lately changed for a ſteam heater. A furnace, having a boiler of five or ſix feet diameter and three feet deep, is heated about one o'clock in the morning with two hundred weight of coals, and the water kept in briſk ebullition. Pipes go off from this boiler to ſix vats, ſome of which are at 90 feet diſtance. It is conveyed into a flat box or veſſel in the midſt of the pulp where it condenſes, imparting its heat to the ſides of the box, and thus heats the ſurrounding pulp. Theſe ſix vats are as completely heated in three hours, expending about three hundred weight of coals, as they were formerly in eight hours, expending near 18 hundred weight of coals. Mr Gregory, the inventor of this ſteam-heater, has obtained (in company with Mr Scott plumber, Edinburgh) a patent for the invention; and we are perſuaded that it will come into very general uſe for many ſimilar purpoſes. The dyers, hatmakers, and many other manufacturers, have occaſion for large vats kept in a continual heat; and there ſeems no way ſo effectual.

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Indeed when we reflect ſeriouſly on the ſubject, we ſee that this method has immenſe advantages conſidered merely as a mode of applying heat. The ſteam may be applied to the veſſel containing the victuals in every part of its ſurface: it may even be made to enter the veſſel, and apply itſelf immediately to the piece of meat that is to be dreſſed, and this without any riſk of ſcorching or overdoing.—And it will give out about $\frac{7999}{8000}$ of the heat which it contains, and will do this only if it be wanted; ſo that no heat whatever is waſted except what is required for heating the apparatus. Experience ſhows that this is a mere trifle in compariſon of what was ſuppoſed neceſſary. But with an open fire we only apply the flame and hot air to the bottom and part of the ſides of our boiling veſſels: and this application is hurried in the extreme; for to make a great heat, we muſt have a great fire, which requires a prodigious and moſt rapid current of air. This air touches our pans but for a moment, imparts to them but a ſmall portion of its heat; and, we are perſuaded that three-fourths of the heat is carried up the chimney, and eſcapes in pure waſte, while another great portion beams out into the kitchen to the great annoyance of the ſcorched cook. We think, therefore, that a page or two of this work will not be thrown away in the deſcription of a contrivance by which a ſaving may be made to the entertainer, and the providing the pleaſures of his table prove a leſs fatiguing taſk to this valuable corps of practical chemiſts.

Let A repreſent a kitchen-boiler, either properly fitted up in a furnace, with its proper fire place, aſh-pit, and flue, or ſet on a tripod on the open fire, or built up in the general fire place. The ſteam-pipe BC riſes from the cover of this boiler, and then is led away with a gentle aſcent in any convenient direction. C repreſents the ſection of this conducting ſteam-pipe. Branches are taken off from the ſide at proper diſtances. One of theſe is repreſented at CDE, furniſhed with a cock D, and having a taper nozzle E, fitted by grinding into a conical piece F, which communicates with an upright pipe GH, which is ſoldered to the ſide of the ſtewing veſſel PQRS, communicating with it by the ſhort pipe I. The veſſel is fitted with a cover OT, having a ſtaple handle V. The piece of meat M is laid on a tin-plate grate KL, pierced with holes like a cullender, and ſtanding on three ſhort feet *n n n*. Plate CCCLXXII. fig. 5.

The ſteam from the boiler comes in by the pipe I, and is condenſed by the meat and by the ſides of the veſſel, communicating to them all its heat. What is not ſo condenſed eſcapes between the veſſel and its cover. The condenſed water lies on the bottom of the veſſel, mixed with a very ſmall quantity of gravy and fatty matter from the victuals. Frequently, inſtead of a cover, another ſtew-veſſel with a cullender bottom is ſet on this one, the bottom of the one fitting the mouth of

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of the other: and *it is obſerved*, that when this is done, the diſh in the under veſſel is more expeditiouſly and better dreſſed, and the upper diſh is more ſlowly, but as completely ſtewed.

This deſcription of one ſtewing veſſel may ſerve to give a notion of the whole; only we muſt obſerve, that when broths, ſoups, and diſhes with made ſauces or containing liquids, are to be dreſſed, they muſt be put into a ſmaller veſſel, which is ſet into the veſſel PQRS, and is ſupported on three ſhort feet, ſo that there may be a ſpace all round it of about an inch or three quarters of an inch. It is obſerved, that diſhes of this kind are not ſo expeditiouſly cooked as on an open fire, but as completely in the end, only requiring to be turned up now and then to mix the ingredients; becauſe as the liquids in the inner veſſel can never come into ebullition, unleſs the ſteam from the boiler be made of a dangerous heat, and every thing be cloſe confined, there cannot be any of that tumbling motion that we obſerve in a boiling pot.

The performance of this apparatus is far beyond any expectation we had formed of it. In one which we examined, ſix pans were ſtewing together by means of a boiler 10½ inches in diameter, ſtanding on a briſk open fire. It boiled very briſkly, and the ſteam puffed frequently through the chinks between the ſtew-pans and their covers. In one of them was a piece of meat conſiderably above 30 pounds weight. This required above four hours ſtewing, and was then very thoroughly and equally cooked; the outſide being no more done than the heart, and it was near two pounds heavier than when put in, and greatly ſwelled. In the mean time, ſeveral diſhes had been dreſſed in the other pans. As far as we could judge, this cooking did not conſume one-third part of the fuel which an open fire would have required for the ſame effect.

When we conſider this apparatus with a little more knowledge of the mode of operation of fire than falls to the ſhare of the cooks (we ſpeak with deference), and conſider the very injudicious manner in which the ſteam is applied, we think that it may be improved ſo as to ſurpaſs any thing that the cook can have a notion of.

When the ſteam enters the ſtew-pan, it is condenſed on the meat and on the veſſel; but we do not want it to be condenſed on the veſſel. And the ſurface of the veſſel is much greater than that of the meat, and continues much colder; for the meat grows hot, and continues ſo, while the veſſel, made of metal which is a very perfect conductor of heat, is continually robbed of its heat by the air of the kitchen, and carried off by it. If the meat touch the ſide of the pan in any part, no ſteam can be applied to that part of the meat, while it is continually imparting heat to the air by the intermedium of the veſſel. Nay, the meat can hardly be dreſſed unleſs there be a current of ſteam through it; and we think this confirmed by what is obſerved above, that when another ſtew-pan is ſet over the firſt, and thus gives occaſion to a current of ſteam through its cullender bottom to be condenſed by its ſides and contents, the lower diſh is more expeditiouſly dreſſed. We imagine, therefore, that not leſs than half of the ſteam is waſted on the ſides of the different ſtew-pans. Our firſt attention is therefore called to this circumſtance, and we wiſh to apply the ſteam more economically and effectually.

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We would therefore conſtruct the ſteam-kitchen in the following manner:

We would make a wooden cheſt (which we ſhall call the STEW-CHEST) A B C D. This ſhould be made of deal, in very narrow ſlips, not exceeding an inch, that it may not ſhrink. This ſhould be lined with very thin copper, lead, or even ſtrong tinfoil. This will prevent it from becoming a conductor of heat by ſoaking with ſteam. For further ſecurity it might be ſet in another cheſt, with a ſpace of an inch or two all round, and this ſpace filled with a compoſition of powdered charcoal and clay. This ſhould be made by firſt making a mixture of fine potter's clay and water about as thick as poor cream: then as much powdered charcoal muſt be beat up with this as can be made to ſtick together. When this is rammed in and dry, it may be hot enough on one ſide to melt glaſs, and will not diſcolour white paper on the other. Fig. 6.

This cheſt muſt have a cover L M N O, alſo of wood, having holes in it to receive the ſtew-pans P, Q, R. Between each pan is a wooden partition, covered on both ſides with milled lead or tinfoil. The whole top muſt be covered with very ſpungy leather or felt, and made very flat. Each ſtew-pan muſt have a bearing or ſhoulder all round it, by which it is ſupported, reſting on the felt, and lying ſo true and cloſe that no ſteam can eſcape. Some of the pans ſhould be ſimple, like the pan F, for dreſſing broths and other liquid diſhes. Others ſhould be like E and G, having in the bottom a pretty wide hole H, K, which has a pipe in its upper ſide, riſing about an inch or an inch and half into the ſtew-pan. The meat is laid on a cullender plate, as in the common way; only there muſt be no holes in the cullender immediately above the pipe.—Theſe ſtew-pans muſt be fitted with covers, or they may have others fitted to their mouths, for warming ſauces or other diſhes, or ſtewing greens, and many other ſubordinate purpoſes for which they may be fitted.

The main-pipe from the boiler muſt have branches, (each furniſhed with a cock), which admit the ſteam into theſe diviſions. At its firſt entry ſome will be condenſed on the bottom and ſides; but we imagine that theſe will in two minntes be heated ſo as to condenſe no more, or almoſt nothing. The ſteam will alſo quickly condenſe on the ſtew-pan, and in half a minute make it boiling hot, ſo that it will condenſe no more; all the reſt will now apply itſelf to the meat and to the cover. It may perhaps be adviſable to allow the cover to condenſe ſteam, and even to waſte it. This may be promoted by laying on it flannel ſoaked in water. Our view in this is to create a demand for ſteam, and thus produce a current through the ſtew-pan, which will be applied in its paſſage to the victuals. But we are not certain of the neceſſity of this. Steam is not like common air of the ſame temperature, which would glide along the ſurfaces of bodies, and impart to them a ſmall portion of its heat, and eſcape with the reſt. To produce this effect there *muſt* be a current; for air hot enough to melt lead, will not boil water, if it be kept ſtagnant round the veſſel. But ſteam imparts the *whole* of its latent heat to any body colder than boiling water, and goes no farther till this body be made boiling hot.

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It is a moſt faithful carrier of heat, and will deliver its whole charge to any body that can take it. Therefore, although there were no partitions in the ſtew-cheſt, and the ſteam were admitted at the end next the boiler, if the pan at the farther end be colder than the reſt, it will all go thither; and will, in ſhort, communicate to every thing impartially according to the demand. If any perſon has not the confidence in the ſteam which we expreſs, he may ſtill be certain that there muſt be a prodigious ſaving of heat by confining the whole in the ſtew-cheſt; and he may make the pans with entire bottoms, and admit the ſteam into them in the common way, by pipes which come through the ſides of the cheſt and then go into the pan. There will be none loſt by condenſation on the ſides of the cheſt; and the pans will ſoon be heated up to the boiling temperature; and hardly any of their heat will be waſted, becauſe the air in the cheſt will be ſtagnant. The chief reaſon for recommending our method is the much greater eaſe with which the ſtew-pans can be ſhifted and cleaned. There will be little difference in the performance.

Nay, even the common ſteam-kitchen may be prodigiouſly improved by merely wrapping each pan in three or four folds of coarſe dry flannel, or making flannel bags of three or four folds fitted to their ſhape, which can be put on or removed in a minute. It will alſo greatly conduce to the good performance to wrap the main ſteam pipe in the ſame manner in flannel.

We ſaid that this main-pipe is conducted from the boiler with a gentle aſcent. The intention of this is, that the water produced by the unavoidable condenſation of the ſteam may run back into the boiler. But the rapid motion of the ſteam generally ſweeps it up hill, and it runs into the branch pipes and deſcends into the ſtew-pans. Perhaps it would be as well to give the main-pipe a declivity the other way, and allow all the water to collect in a hot well at the farther end, by means of a deſcending pipe, having a loaded valve at the end. This may be ſo contrived as to be cloſe by the fire, where it would be ſo warm that it would not check the boiling if again poured into the boiler. But the utmoſt attention muſt be paid to cleanlineſs in the whole of this paſſage, becauſe this water is boiled again, and its ſteam paſſes through the heart of every diſh. This circumſtance forbids us to return into the boiler what is condenſed in the ſtew-pans. This would mix the taſtes and flavours of every diſh, and be very diſagreeable. All this muſt remain in the bottom of each ſtew-pan; for which reaſon we put in the pipe riſing up in the middle of the bottom. It might indeed be allowed to fall down into the ſtew-cheſt, and to be collected in a common receptacle, while the fat would float at top, and the clear gravy be obtained below, perhaps fit for many ſauces.

The completeſt method for getting rid of this condenſed ſteam would be to have a ſmall pipe running along the under ſide of the main conductor, and communicating with it at different places, in a manner ſimilar to the air diſcharger on the mains of water-pipes. In the paper manufacture mentioned above, each ſteam-box has a pipe in its bottom, with a float-cock, by which the water is diſcharged; and the main pipe being of great diameter, and laid with a proper acclivity, the water runs back into the boiler.

But theſe precautions are of little moment in a ſteam-kitchen even for a great table; and for the general uſe of private families, would hurt the apparatus, by making it complex and of nice management. For a ſmall family, the whole apparatus may be ſet on a table four feet long and two broad, which may be placed on caſters, ſo as to be wheeled out of the way when not in uſe. If the main conductor be made of wood, or properly caſed in flannel, it will condenſe ſo little ſteam that the cooking table may ſtand in the remoteſt corner of the kitchen without ſenſibly impairing its performance; and if the boiler be properly ſet up in a ſmall furnace, and the flue made ſo that the flame may be applied to a great part of its ſurface, we are perſuaded that three-fourths of the fuel uſed in common cookery will be ſaved. Its only inconvenience ſeems to be the indiſpenſable neceſſity of the moſt anxious cleanlineſs in the whole apparatus. The moſt trifling neglect in this will deſtroy a whole dinner.

Steam-Kitchen || Steel.

We had almoſt forgotten to obſerve, that the boiler muſt be furniſhed with a funnel for ſupplying it with water. This ſhould paſs through the top, and its pipe reach near to the bottom. It will be proper to have a cock on this funnel. There ſhould alſo be another pipe in the top of the boiler, having a valve on the top. If this be loaded with a pound on every ſquare inch, and the fire ſo regulated that ſteam may be obſerved to puff ſometimes from this valve, we may be certain that it is paſſing through our diſhes with ſufficient rapidity; and if we ſhut the cock on the funnel, and load the valve a little more, we ſhall cauſe the ſteam to blow at the covers of the ſtew-pans. If one of theſe be made very tight, and have a hole alſo furniſhed with a loaded valve, this pan becomes a digeſter, and will diſſolve bones, and do many things which are impracticable in the ordinary cookery.

Si quid noviſti rectius iſtis,
Candidus imperti;—ſi non, his utere noſtris.

STEATITES or *Soap-earth*, a genus of the magneſian order of earths. Of this genus there are ſeveral ſpecies, for which ſee MINERALOGY. According to the analyſis of Bergman, 100 parts of ſteatites contain 80 of ſilex, 17 of mild magneſia, 2 of argillaceous earth, and nearly 1 of iron in a ſemioxidated ſtate.

This ſubſtance may be formed into a paſte with water, ſufficiently ductile to be worked on the potter's wheel; and by expoſure to a great heat it is hardened ſo as to ſtrike fire with ſteel. It has alſo the property of *FULLER's Earth* in cleanſing cloths from greaſe: but it does not diffuſe in water ſo well as clays do; and when digeſted with vitriolic acid, it does not form alum, as clays do, but a ſalt ſimilar to Epſom ſalt. From its ſoftneſs and ductility it may be eaſily formed into pots for the kitchen; and hence it has got the name of *lapis ollaris*.

STEATOMA, a kind of encyſted tumor, conſiſting of a matter like ſuet or lard, ſoft, without pain, and without diſcolouring the ſkin.

STEEL, iron united with carbone. See IRON.

Steel has properties diſtinct from thoſe of iron, which render it of ſuperior value. From its higher degree of hardneſs it admits a finer poliſh and aſſumes a brighter colour. When tempered, it poſſeſſes a higher degree of elaſticity, and is alſo more ſonorous. It is more weakly attracted by the loadſtone, it receives more ſlowly the magnetic power, but it preſerves it longer. When expoſed to a moiſt air, it does not contract ruſt ſo eaſily as

Steel. iron. It is alſo heavier, increaſing in weight, according to Chaptal, one hundred and ſeventieth part. M. Rinman has given as the reſult of ſeveral accurate experiments on different kinds of ſteel the following ſpecific gravity 7,795, while he makes ductile iron 7,700, and crude iron 7,251.

All iron is convertible into ſteel by expoſing it to a certain degree of heat for a certain time along with a quantity of charcoal. Chemiſts differ in opinion concerning the nature and effects of this proceſs. Some ſay that ſteel is produced by abſorbing a quantity of caloric or heat in a latent ſtate, as the older chemiſts had ſaid it was formed by abſorbing phlogiſton. Lavoiſier ſeems to have aſcribed the qualities of ſteel to a ſlight degree of oxidation, others to a combination with plumbago or black lead, and others to a union with carbone. In agreeing with thoſe who ſay the formation of ſteel is owing to carbone, we do not differ eſſentially from thoſe who attribute it to plumbago; for the art of chemiſtry has now found that theſe ſubſtances are very nearly allied. Plumbago is a true charcoal combined with a little iron. The brilliant charcoal of certain vegetable ſubſtances, more eſpecially when formed by diſtillation in cloſe veſſels, poſſeſſes all the characters of plumbago. The charcoal of animal ſubſtances poſſeſſes characters ſtill more peculiarly reſembling it. Like it they are difficult to incinerate, they leave the ſame impreſſion on the hands and upon paper; they likewiſe contain iron, and become converted into carbonic acid by combuſtion. When animal ſubſtances are diſtilled by a ſtrong fire, a very fine powder ſublimes, which attaches itſelf to the inner part of the neck of the retort, and this ſubſtance may be made into excellent black lead pencils.

Chaptal's Chemiſtry, vol. ii. p. 347.

There are two ways of making ſteel, namely, by fuſion and by cementation. The firſt way is uſed to convert iron into ſteel immediately from the ore, or from crude or caſt-iron. By the ſecond way, bar-iron is expoſed to a long continued heat ſurrounded by charcoal. Each of theſe ways has advantages peculiar to itſelf; but the ſame cauſes in fact predominate in both, for both kinds of ſteel are produced by heat and charcoal. The only difference between the two methods is this; in making ſteel by fuſion the charcoal is not ſo equally defended from the acceſs of air as in the other way.

Swedenborgius has given the following deſcription of the method uſed in Dalecarlia for making ſteel from caſt-iron. The ore from which the crude iron to be converted into ſteel is obtained is of a good kind. It is black, friable, and compoſed of many ſmall grains, and it produces very tough iron. The converſion into ſteel is made upon a forge-hearth, ſomething ſmaller than common. The ſides and bottom are made of caſt-iron. The tuyere is placed, with very little inclination, on one of the ſide-plates. The breadth of the fire-place is fourteen inches; its length is greater. The lower part of the tuyere is ſix inches and a half above the bottom. In the interior part of the fire-place there is an oblong opening for the flowing of the ſuperfluous ſcoriæ. The workmen firſt put ſcoriæ on the bottom, then charcoal and powder of charcoal, and upon theſe the caſt-iron run or cut into ſmall pieces. They cover the iron with more charcoal, and excite the fire. When the pieces of iron are of a red white, and before they begin to melt, they ſtop the bellows, and carry the maſs under a large hammer, where they break it into pieces of three or four pounds each. The pieces are again brought to the hearth, and laid within reach of the workman, who plunges ſome of them into the fire, and covers them with coal. The bellows are made to blow ſlowly till the iron is liquefied. Then the fire is increaſed; and when the fuſion has been long enough continued, the ſcoriæ are allowed to flow out; and at that time the iron hardens. The workman adds more of the pieces of crude iron, which he treats in the ſame manner; and ſo on a third and a fourth time, till he obtains a maſs of ſteel of about a hundred pounds, which is generally done in about four hours. This maſs is raiſed and carried to the hammer, where it is forged, and cut into four pieces, which are farther beat into ſquare bars four or five feet long. When the ſteel is thus forged, it is thrown into water that it may be eaſily broken; for it is yet crude and coarſe-grained. The ſteel is then carried to another hearth ſimilar to the former, and there broken in pieces. Theſe pieces are laid regularly in the fire-place, firſt two parallel, upon which ſeven or eight others are placed acroſs; then a third row acroſs the ſecond, in ſuch a manner that there is ſpace left between thoſe of the ſame row. The whole is then covered with charcoal, and the fire is excited. In about half or three quarters of an hour the pieces are made hot enough, and are then taken from the fire, one by one, to the hammer, to be forged into little bars from half a foot to two feet long, and while hot are thrown into water to be hardened. Of theſe pieces ſixteen or twenty are put together ſo as to make a bundle, which is heated and welded, and afterwards forged into bars four inches thick, which are then broken into pieces of convenient length for uſe. Steel.

The method of converting iron into ſteel by cementation is a very ſimple proceſs. It conſiſts ſolely in expoſing it for a certain time to a ſtrong degree of heat, while cloſely covered with charcoal and defended from the external air. The furnaces employed for converting iron into ſteel (ſays a manufacturer of this metal) are of different ſizes; ſome capable of converting only three or four tons weight, while others are capacious enough to contain from ſeven to eight or ten tons. The outſides of theſe furnaces riſe up in the form of a cone, or ſugar-loaf, to the height of a very conſiderable number of feet. In the inſide, oppoſite to each other, are placed two very long cheſts, made either of ſtone, or of bricks capable of bearing the ſtrongeſt fire; which is placed between the two cheſts. The bars of iron, after the bottom is furniſhed with a neceſſary quantity of charcoal duſt, are laid in *ſtratum ſuper ſtratum*, with intermediate beds of the charcoal duſt, to ſuch a height of the cheſts as only to admit of a good bed at top; which is then all covered over, to prevent the admiſſion of the common air; which, could it procure an entrance, would greatly injure the operation. The iron being thus ſituated, the fire is lighted; which is ſome time before it can be raiſed to a ſufficient degree of heat to produce any conſiderable effect. After which it is continued for ſo many days as the operator may judge proper; only now and then drawing out what they call a proof bar. This is done by openings fit for the purpoſe at the ends of the cheſt, which are eaſily and with expedition ſtopped up again, without occaſioning any injury to the contents left behind. When the operator

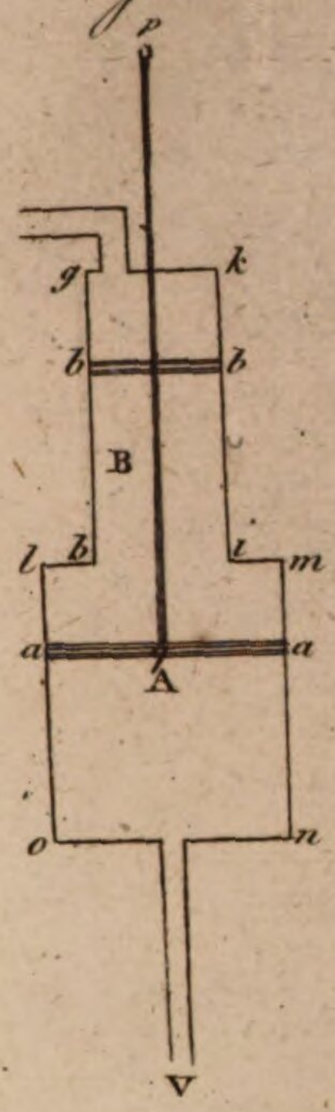
Plate CCCCLXXX.

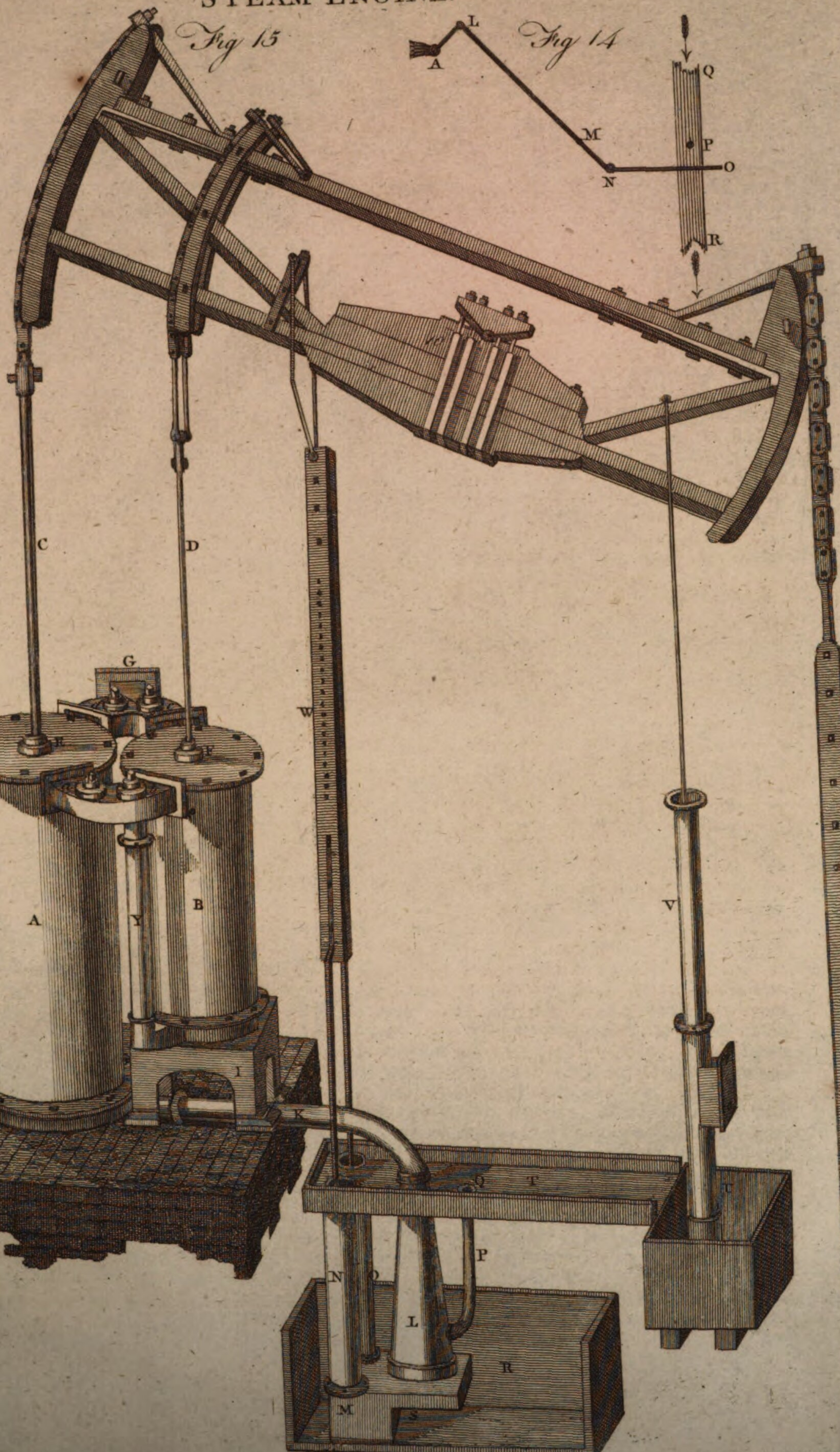
Hornblower's STEAM ENGINE.

Fig 15

Fig 14

Fig 16





A. Bell. Print.d Wal.t Sculptor fec.t

Steel. tor apprehends the converſion is ſufficiently completed, the fire is ſuffered to go out, and the furnace, with its contents, is left gradually to cool. This may take up ſeveral days: after which the furnace is diſcharged, by taking out the bars of ſteel and the remainder of the charcoal duſt.

There is a manufactory eſtabliſhed in the pariſh of Cramond, about five miles from Edinburgh, in which this method is practiſed with great ſucceſs. Great quantities of ſteel are made there, which we have reaſon to believe is of as excellent a quality as any that can be procured from other countries.

When the charcoal is taken out, it is found as black as before it was introduced into the furnace, unleſs by accident the external air has got admittance. The bars preſerve their exterior form only; the ſurface frequently exhibits a great number of tumors or bliſters, whence they are called *bliſtered ſteel*.

The hardneſs of ſteel is much increaſed by tempering. This conſiſts in heating it to a red heat, and then plunging it ſuddenly into cold water. If it be allowed to cool ſlowly, it ſtill preſerves its ductility; or if it be heated again after being tempered, it loſes its hardneſs, and again becomes ductile. In heating ſteel for tempering it, the moſt remarkable circumſtance is, the different colours it aſſumes, according to the degree of heat it has received. As it is gradually heated, it becomes white, then yellow, orange, purple, violet, and at laſt of a deep blue colour.

According to Reaumur, the ſteel which is moſt heated in tempering is generally the hardeſt. Hence it is believed, that the more violent the heat to which ſteel is expoſed, and the more ſuddenly it is plunged into cold water, the harder the ſteel will be. Rinman, again, has deduced a concluſion directly oppoſite, that the ſteel which is naturally hardeſt demands the leaſt degree of heat to temper it. Different methods have been propoſed to determine what degree of heat is moſt proper; but the eaſieſt method is to take a bar of ſteel, ſo long, that while one end is expoſed to a violent heat, the other may be kept cold. By examining the intermediate portions, it may be found what degree of heat has produced the greateſt hardneſs.

By tempering, ſteel is ſaid to increaſe both in bulk and in weight. Reaumur ſays, that a ſmall bar ſix inches long, ſix lines broad, and half an inch thick, was increaſed at leaſt a line in length after being tempered to a reddiſh white colour; that is, ſuppoſing the dilatation proportional in all dimenſions increaſing at the rate of 48 to 49. Iron alſo expands when heated; but when the heat paſſes off, it returns to its former dimenſions. That the weight of ſteel is alſo augmented by tempering, has been found by experiment. Rinman having weighed exactly in an hydroſtatic balance two kinds of fine ſteel made by cementation, and not tempered, found their denſity to be to that of water as 7,991 to 1; after being tempered, the denſity of the one was 7,553, and that of the other 7,708. M. de Morveau took three bars juſt of a ſize to enter a certain caliber 28 lines long, and each ſide two lines broad; one of the bars was ſoft iron, and the two others were taken from the ſame piece of fine ſteel. In order to communicate an equal degree of heat to each, in an earthen veſſel in the midſt of a wind furnace, the bar of ſoft iron and one of the bars of ſteel were thrown into cold water; the other bar of ſteel was cooled ſlowly over ſome pieces of charcoal at a diſtance from the furnace. The bar of iron and the one of ſteel that was allowed to cool ſlowly paſſed eaſily into the caliber again; but the bar of tempered ſteel was lengthened almoſt one-ninth of a line. Steel.

There is no doubt but tempering changes the grain; that is, the appearance of the texture of a piece of ſteel when broken. This is the mark which is uſually obſerved in judging of the quality of ſteel, or of the tempering which ſuits it beſt. The tempered bar is broken in ſeveral places after having received different degrees of heat in different places. What proves completely the effect of heat upon the grain, at leaſt in ſome kinds of ſteel, is, that a bar of ſteel expoſed to all the intermediate degrees of heat, from the ſmalleſt ſenſible heat to a red heat, is found to increaſe in fineneſs of grain from the ſlightly heated to the ſtrongly heated end. The celebrated Rinman has made many experiments on the qualities of ſteel expoſed to different degrees of heat in tempering, but particularly to three kinds, viz. ſteel heated to an obſcure red, to a bright red, and to a red white. Hard brittle ſteel, made by cementation, and heated to an obſcure red and tempered, exhibited a fine grain, ſomewhat ſhining, and was of a yellow white colour. When tempered at a bright red heat, the grain was coarſer and more ſhining; when tempered at a red white heat, the grain was alſo coarſe and ſhining.

With a view to determine how far ſteel might be improved in its grain by tempering it in different ways, M. de Morveau took a bar of bliſtered ſteel, and broke it into four parts nearly of the ſame weight. They were all heated to a red heat in the ſame furnace, and withdrawn from the fire at the ſame inſtant. One of the pieces was left at the ſide of the furnace to cool in the air, the ſecond was plunged into cold water, the third into oil, and the fourth into mercury. The piece of ſteel that was cooled in the air reſiſted the hammer a long time before it was broken; it was neceſſary to notch it by the file, and even then it was broken with difficulty. It ſhowed in its fracture a grain ſenſibly more fine and more ſhining than it was before. The ſecond piece, which had been plunged into water, broke eaſily: its grain was rather finer than the firſt, and almoſt of the ſame white colour. The third piece, which was tempered in oil, appeared very hard when tried by the file; it was ſcarcely poſſible to break it. Its grain was as fine, but not quite ſo bright, as that which was tempered in water. The fourth piece, which was dipped into mercury, was evidently ſuperior to all the reſt in the fineneſs and colour of the grain. It broke into many fragments with the firſt ſtroke of the hammer, the fractures being generally tranſverſe.

M. de Morveau was not altogether ſatisfied with theſe experiments, and therefore thought it neceſſary to repeat them with finer ſteel. He took a bar of ſteel two lines ſquare, ſuch as is uſed in Germany for tools by engravers and watchmakers; he divided it into four pieces, and treated them in the ſame way as he had done the bliſtered ſteel. The firſt piece, which was cooled in the air, it was very difficult to break: the fracture appeared in the midſt of the grain very fine, but white and ſhining. The ſecond, which was tempered in water, was broken into three fragments at the

Steel, Steel-yard.

first blow; its grain was perfectly equal, of a grey ash-colour, and of remarkable fineneſs. One of its ſides was poliſhed, and a drop of the nitrous acid which was poured upon it left a black ſpot, but not deep. But when a drop of the ſame acid was poured on the middle of the fracture, after it had been equally poliſhed, it left a black ſpot much deeper. The third piece, which was plunged in oil, bent as eaſily as the piece which was cooled in the air; the file made an impreſſion on it with difficulty; it was neceſſary to break it with a vice: its grain was inferior in fineneſs to the ſecond, but it was of a darker colour. The fourth, which was tempered in mercury, exhibited a grain of an intermediate fineneſs between the ſecond and the third. From theſe experiments, it appears that ſteel may be hardened by tempering it, not only with water, but with any other liquid which is capable of accelerating its cooling.

Steel may be unmade, or reduced to the ſtate of iron, by a management ſimilar to that by which it is made, that is, by cementation. But the cement uſed for this purpoſe muſt be compoſed of ſubſtances entirely free from inflammable matter, and rather capable of abſorbing it, as calcareous earth or quicklime. By a cementation with calcareous earth, continued during eight or ten hours, ſteel is reduced to the ſtate of iron. After it has been tempered, it may be again untempered, and ſoftened to any degree that we think proper; for which purpoſe we have only to heat it more or leſs, and to let it cool ſlowly. By this method we may ſoften the hardeſt-tempered ſteel.

Steel-Bow Tenants. See Tenure.

Salt of Steel. See Chemistry, n° 697.

Steel-Yard, is one of the moſt ancient preſents which ſcience has made to ſociety; and though long in deſuetude in this country, is in moſt nations of the world the only inſtrument for aſcertaining the weight of bodies. What is tranſlated *balance* in the Pentateuch, is in fact ſteelyard, being the word uſed by the Arabs to this day for their inſtrument, which is a ſteelyard. It is in common uſe in all the Aſiatic nations. It was the *ſtatera* of the Greeks and Romans, and ſeems to have been more confided in by them than the balance; for which reaſon it was uſed by the goldſmiths, while the balance was the inſtrument of the people.—*Non aurificis ſtatera ſed populari trutina examinare.* Cic. de Or. 238.

The ſteelyard is a lever of unequal arms, and, in its moſt perfect form, is conſtructed much like a common balance. It hangs in ſheers E (fig. 1.) reſting on the nail C, and the ſcale L for holding the goods hangs by a nail D on the ſhort arm BC. The counter weight P hangs by a ring of tempered ſteel, made ſharp in the inſide, that it may bear by an edge on the long arm CA of the ſteelyard. The under edge of the centre nail C, and the upper edge of the nail D, are in the ſtraight line formed by the upper edge of the long arm. Thus the three points of ſuſpenſion are in one ſtraight line. The needle or index of the ſteelyard is perpendicular to the line of the arms, and plays between the ſheers. The ſhort arm may be made ſo maſſive, that, together with the ſcale, it will balance the long arm unloaded. When no goods are in the ſcale, and the counter weight with its hook are removed, the ſteelyard acquires a horizontal poſition, in conſequence of its centre of gravity being below the axis of ſuſpenſion. The rules for its accurate conſtruction are the ſame as for a common balance. Steel-yard.

Plate CCCCLXXXI.

The inſtrument indicates different weights in the following manner: The diſtance CD of the two nails is conſidered as an unit, and the long arm is divided into a number of parts equal to it; and theſe are ſubdivided as low as is thought proper: or in general, the long arm is made a ſcale of equal parts, commencing at the edge of the nail C; and the ſhort arm contains ſome determined number of thoſe equal parts. Suppoſe, then, that a weight A of 10 pounds is put into the ſcale L. The counterpoiſe P muſt be of ſuch a weight, that, when hanging at the diviſion 10, it ſhall balance this weight A. Now let any unknown weight W be put into the ſcale. Slide the hook of the counterpoiſe along the long arm till it balances this weight. Suppoſe it then hanging at the diviſion 38. We conclude that there is 38 pounds in the ſcale. This we do on the authority of the fundamental property of the lever, that forces acting on it, and balancing each other, are in the inverſe proportion of the diſtances from the fulcrum to their lines of direction. Whatever weight the counterpoiſe is, it is to A as CD to 10, and it is to the weight W as CD to 38; therefore A is to the weight W as 10 to 38, and W is 38 pounds: and thus the weight in the ſcale will always be indicated by the diviſion at which it is balanced by the counterpoiſe.

Our well informed readers know that this fundamental property of the lever was diſcovered by the renowned Archimedes, or at leaſt firſt demonſtrated by him; and that his demonſtration, beſides the defect of being applicable only to commenſurable lengths of the arms, has been thought by metaphyſicians of the firſt note to proceed on a poſtulate which ſeems equally to need a demonſtration. It has accordingly employed the utmoſt refinement of the firſt mathematicians of Europe to furniſh a demonſtration free from objection. Mr D'Alembert has given two, remarkable for their ingenuity and ſubtlety; Foncenex has done the ſame; and Profeſſor Hamilton of Trinity-college, Dublin, has given one which is thought the leaſt exceptionable. But critics have even objected to this, as depending on a poſtulate which ſhould have been demonſtrated.

Since we publiſhed the volume containing the article Mechanics, there has appeared (Phil. Tranſ. 1794) a demonſtration by Mr Vince, which we think unexceptionable, and of ſuch ſimplicity that it is aſtoniſhing that it has not occurred to any perſon who thinks on the ſubject. Our readers will not be diſpleaſed with an account of it.

Let AE (fig. 2.) be a mathematical lever, or inflexible ſtraight line, reſting on the prop A, and ſupported at E by a force acting upwards. Let two equal weights *b* and *d* be hung on at B and D, equidiſtant from A and E. Preſſures are now exerted at A and E; and becauſe every circumſtance of weight and diſtance is the ſame, the preſſure at E, ariſing from the action of the weight *b* on the point B, muſt be the ſame with the preſſure at A, ariſing from the action of the weight *d* on the point D; and the preſſure at E, occaſioned by the weight *d*, muſt be the ſame with the preſſure at A, occaſioned by the weight *b*. This muſt be the caſe wherever the weights are hung, provided that the diſtance AB and DE are equal. Moreover,

the

Steel-yard. the ſum of the preſſures at A and E is unqueſtionably equal to the ſum of the weights, becauſe the weights are ſupported ſolely at A and E. Let the two weights be hung on at C the middle point; the preſſure at E is ſtill the ſame. Therefore, in general, the preſſure excited at the point E, by two equal weights hanging at any points B and D, is the ſame as if they were hung on at the middle point between them: but the preſſure excited at E is a juſt meaſure of the effort or energy of the weights *b* and *d* to urge the lever round the point A. It is, at leaſt, a meaſure of the oppoſite force which muſt be applied at E to ſuſtain or balance this preſſure. A very faſtidious metaphyſician may ſtill ſay, that the demonſtration is limited to a point E, whoſe diſtance from A is twice AC, or = AB + AD. But it extends to any other point, on the authority of a poſtulate which cannot be refuſed, viz. that in whatever proportion the preſſure at E is augmented or diminiſhed, the preſſure at this other point muſt augment or diminiſh in the ſame proportion. This being proved, the general theorem may be demonſtratedin all proportions of diſtance, in the manner of Archimedes, at once the moſt ſimple, perſpicuous, and elegant of all.

We cannot help obſerving, that all this difficulty (and it is a real one to the philoſopher who aims at rendering mechanics a demonſtrative ſcience) has ariſen from an improper ſearch after ſimplicity. Had Archimedes taken a lever as it really exiſts in nature, and conſidered it as *material*, conſiſting of atoms united by coheſion; and had he traced the intermediate preſſures by whoſe means the two external weights are put in oppoſition to each other, or rather to the ſupport given to the fulcrum; all difficulty would have vaniſhed. (See what is ſaid on this ſubject in the article *Strength of Timber*, &c.)

The quantity of goods which may be weighed by this inſtrument depends on the weight of the counterpoiſe, and on the diſtance CD from the fulcrum at which the goods are ſuſpended. A double counterpoiſe hanging at the ſame diviſion will balance or indicate a double quantity of goods hanging at D; and any counterpoiſe will balance and indicate a double quantity of goods, if the diſtance CD be reduced to one-half. Many ſteelyards have two or more points of ſuſpenſion D, to which the ſcale may occaſionally be attached. Fig. 6. of Plate XCI. Vol. II. repreſents one of theſe. It is evident, that in this caſe the value or indication of the diviſions of the long arm will be different, according to the point from which the ſcale is ſuſpended. The ſame diviſion which would indicate 20 pounds when CD is three inches, will indicate 30 pounds when it is two inches. As it would expoſe to chance of miſtakes, and be otherwiſe troubleſome to make this reduction, it is uſual to make as many divided ſcales on the long arm as there are points of ſuſpenſion D on the ſhort arm; and each ſcale having its own numbers, all trouble and all chance of miſtake is avoided.

But the range of this inſtrument is not altogether at the pleaſure of the maker. Beſides the inability of a ſlender beam to carry a great load, the diviſions of the ſcale anſwering to pounds or half-pounds become very minute when the diſtance CD is very ſhort; and the balance becomes leſs delicate, that is, leſs ſenſibly affected by ſmall differences of weight. This is becauſe in ſuch caſes the thickneſs which it is neceſſary to give the edges of the nails does then bear a ſenſible proportion to the diſtance CD between them; ſo that when the balance inclines to one ſide, that arm is ſenſibly ſhortened, and therefore the energy of the preponderating weight is leſſened. Steel-yard.

We have hitherto ſuppoſed the ſteelyard to be in equilibrio when not loaded. But this is not neceſſary, nor is it uſual in thoſe which are commonly made. The long arm commonly preponderates conſiderably. This makes no difference, except in the beginning of the ſcale. The preponderancy of the long arm is equivalent to ſome goods already in the ſcale, ſuppoſe four pounds. Therefore when there are really 10 pounds in the ſcale, the counterpoiſe will balance it when hanging at the diviſion 6. This diviſion is therefore reckoned 10, and the reſt of the diviſions are numbered accordingly.

A ſcientific examination of the ſteelyard will convince us that it is inferior to the balance of equal arms in point of ſenſibility: But it is extremely compendious and convenient; and when accurately made and attentively uſed, it is abundantly exact for moſt commercial purpoſes. We have ſeen one at Leipzig which has been in uſe ſince the year 1718, which is very ſenſible to a difference of one pound, when loaded with nearly three tons on the ſhort arm; and we ſaw a waggon loaded with more than two tons weighed by it in about ſix minutes.

The ſteelyard in common uſe in the different countries of Europe is of a conſtruction ſtill ſimpler than what we have deſcribed. It conſiſts of a batten of hard wood, having a heavy lump A (fig. 3.) at one end, and a ſwivel-hook B at the other. The goods to be weighed are ſuſpended on the hook, and the whole is carried in a loop of whip-cord C, in which it is ſlid backward and forward, till the goods are balanced by the weight of the other end. The weight of the goods is eſtimated by the place of the loop on a ſcale of diviſions in harmonic progreſſion. They are marked (we preſume) by trial with known weights.

The chief uſe that is now made of the ſteelyard in theſe kingdoms is for the weighing of loaded waggons and carts. For this it is extremely convenient, and more than ſufficiently exact for the purpoſe in view. We ſhall deſcribe one or two of the moſt remarkable; and we ſhall begin with that at Leipzig already mentioned.

This ſteelyard is repreſented in fig. 4. as run out, and juſt about to be hooked for lifting up the load. The ſteelyard itſelf is OPQ, and is about 12 feet long. The ſhort arm PQ has two points of ſuſpenſion *c* and *b*; and the ſtirrup which carries the chains for holding the load is made with a double hook, inſtead of a double eye, that it may be eaſily removed from the one pin to the other. For this purpoſe the two hooks are connected above by an haſp or ſtaple, which goes over the arm of the ſteelyard like an arch. This is repreſented in the little figure above the ſteelyard. The ſuſpenſion is ſhifted when the ſteelyard is run in under cover, by hooking to this ſtaple the running block of a ſmall tackle which hangs in the door through which the ſteelyard is run out and in. This operation is eaſy,

Steel-yard. but neceſſary, becauſe the ſtirrup, chains, and the ſtage on which the load is placed, weigh ſome hundreds.

The outer pin *b* is 14 inches, and the inner one *c* is ſeven inches, diſtant from the great nail which reſts in the ſheers. The other arm is about 10½ feet long, formed with an obtuſe edge above. On the inclined plane on each ſide of the ridge is drawn the ſcale of weights adapted to the inner pin *c*. The ſcales correſponding to the outer pin *b* are drawn on the upright ſides. The counterpoiſe ſlides along this arm, hanging from a ſaddle-piece made of braſs, that it may not contract ruſt. The motion is made eaſy by means of rollers. This is neceſſary, becauſe the counterpoiſe is greatly above a hundred weight. This ſaddle-piece has like two laps on each ſide, on which are engraved vernier ſcales, which divide their reſpective ſcales on the arm to quarters of a pound. Above the ſaddle is an arch, from the ſummit of which hangs a little plummet, which ſhows the equilibrium of the ſteelyard to the weigher, becauſe the ſheers are four feet out of the houſe, and he cannot ſee their coincidence with the needle of the ſteelyard. Laſtly, near the end of the long arm are two pins *d* and *e*, for ſuſpending occaſionally two eke weights for continuing the ſcale. Theſe are kept hanging on adjoining hooks, ready to be lifted on by a little tackle, which is alſo hooked immediately above the pins *d* and *e*.

The ſcales of weights are laid down on the arm as follows. Let the eke-weights appropriated to the pins *d* and *e* be called D and E, and call the counterpoiſe C. Although the ſtirrup with its chains and ſtage weigh ſome hundreds, yet the length and ſize of the arm OP gives it a preponderancy of 300 pounds. Here, then, the ſcale of weights muſt commence. The counterpoiſe weighs about 125 pounds. Therefore,

1. When the load hangs by the pin *b*, 14 inches from the centre, the diſtance from one hundred to another on the ſcale is about 11 inches, and the firſt ſcale (on the ſide of the arm) reaches from 300 to 1200. In order to repeat or continue this, the eke-weight E is hung on the pin *e*, and the counterpoiſe C is brought back to the mark 300; and the two together balance 1100 pounds hanging at *b*. Therefore a ſecond ſcale is begun on the ſide of the arm, and continued as far out as the firſt, and therefore its extremity marks 2000; that is, the counterpoiſe C at 2000 and the eke-weight E at *e* balance 2000 hanging at *b*.

2. To continue the ſcale beyond 2000, the load muſt be hung on the inner pin *c*. The eke-weight E is taken off, and the eke-weight D is hung on its pin *d*. The general counterpoiſe being now brought cloſe to the ſheers, it, together with the weight D at *d*, balance 2000 pounds hanging at *c*. A ſcale is therefore begun on one of the inclined planes a-top, and continued out to 4000, which falls very near to the pin *d*, each hundred pounds occupying about five inches on the arm. To complete the ſcale, hang on the eke-weight E on its pin *e*, and bring back the counterpoiſe to the ſheers, and the three together balance 3800 hanging at *c*. Therefore when the counterpoiſe is now ſlid out to 4000, it muſt complete the balance with 5800 hanging at *c*.

It required a little conſideration to find out what proportion of the three weights C, D, and E, would make the repetitions of the ſcale extend as far as poſ- Steel-yard.
ſible, having very little of it expreſſed twice, or upon two ſcales, as is the caſe here. We ſee that the ſpace correſponding to a ſingle pound is a very ſenſible quantity on both ſcales, being one-ninth of an inch on the firſt two ſcales, and one-twentieth on the laſt two.

This very ponderous machine, with its maſſy weights, cannot be eaſily managed without ſome aſſiſtance from mechanics. It is extremely proper to have it ſuſceptible of motion out and in, that it may be protected from the weather, which would ſoon deſtroy it by ruſt. The contrivance here is very effectual, and abundantly ſimple.

When the ſteelyard is not in uſe, it is ſupported at one end by the iron-rod F, into which the upper end of the ſheers is hooked. The upper end of this rod has a ſtrong hook E, and a little below at *a* it is pierced with a hole, in which is a very ſtrong bolt or pin of tempered ſteel, having a roller on each end cloſe to the rod on each ſide. Theſe rollers reſt on two joiſts, one of which is repreſented by M N, which traverſe the building, with juſt room enough between them to allow the rod F to hang freely down. The other end O of the ſteelyard reſts in the bight of a large flat hook at the end of a chain W, which hangs down between the joiſts, and is ſupported on them by a frame with rollers H. This is connected with the rollers at G, which carry the ſheers by means of two iron-rods, of which one only can be ſeen. Theſe connect the two ſets of rollers in ſuch a manner that they muſt always move together, and keep their diſtance invariable. This motion is produced by means of an endleſs rope HI ZLKVH paſſing over the pulleys I and K, which turn between the joiſts, and hanging down in a bight between them. It is evident that by pulling on the part LZ we pull the frame of rollers in the direction GH, and thus bring the whole into the houſe in the poſition marked by the dotted figure. It is alſo plain, that by pulling on the part LK we force the roller frame and the whole apparatus out again.

It remains to ſhow how the load is raiſed from the ground and weighed. When the ſteelyard is run out for uſe, the upper hook E juſt enters into the ring D, which hangs from the end of the great oaken lever BCA about 22 feet long, turning on gudgeons at C about 5 feet from this end. From the other end A deſcends a long iron-rod SR, which has one ſide formed into a toothed rack that is acted on by a frame of wheel-work turned by an endleſs ſcrew and winch Q. Therefore when the hook E is well engaged in the ring D, a man turns the winch, and thus brings down the end A of the great lever, and raiſes the load two or three inches from the ground. Every thing is now at liberty, and the weigher now manages his weights on the arm of the ſteelyard till he has made an equilibrium.

We need not deſcribe the operation of letting down the load, diſengaging the ſteelyard from the great lever, and bringing it again under cover. The whole of this ſervice is performed by two men, and may be done in ſucceſſion by one, and is over in five or ſix minutes.

The moſt compendious and economical machine of this kind that we have ſeen is one, firſt uſed (we have heard) for weighing the riders of race-horſes, and afterwards

Steel-yard. terwards applied to the more reputable ſervice of weighing loaded carriages.

Fig. 5. is a plan of the machine. KLMN is the plan of a rectangular box, which has a platform lid or cover, of ſize ſufficient for placing the wheels of a cart or waggon. The box is about a foot deep, and is ſunk into the ground till the platform-cover is even with the ſurface. In the middle of the box is an iron lever ſupported on the fulcrum pin *i k*, formed like the nail of balance, which reſts with its edge on arches of hardened ſteel firmly faſtened to the bottom of the box. This lever goes through one ſide of the box, and is furniſhed at its extremity with a hard ſteel pin *l m*, alſo formed to an edge below. In the very middle of the box it is croſſed by a third nail of hardened ſteel *g h*, alſo formed to an edge, but on the upper ſide. Theſe three edges are in one horizontal plane, as in a well made balance.

In the four corners A, A′, E′, E, of the box are firmly fixed four blocks of tempered ſteel, having their upper ſurfaces formed into ſpherical cavities, well poliſhed and hard tempered. ABCDE repreſents the upper edge of an iron bar of conſiderable ſtrength, which reſts on the cavities of the ſteel blocks in A and E, by means of two hard ſteel ſtuds projecting from its under edge, and formed into obtuſe angled points or cones. Theſe points are in a ſtraight line parallel to the ſide KN of the box. The middle part C of this crooked bar is faced with hard-tempered ſteel below, and is there formed into an edge parallel to AE and KN, by which it reſts on the upper edge of the ſteel pin *g h* which is in the lever. In a line parallel to AE, and on the upper ſide of the crooked bar ACE, are fixed two ſtuds or points of hardened ſteel B and D projecting upwards above half an inch. The platform-cover has four ſhort feet like a ſtool, terminated by hard ſteel ſtuds, which are ſhaped into ſpherical cavities and well poliſhed. With theſe it reſts on the four ſteel points B, B′, D′, D. The bar ACE is kneed in ſuch a manner vertically, that the points A, B, D, E and the edge C are all in a horizontal plane. Theſe particulars will be better underſtood by looking at the elevation in fig. 6. What has been ſaid of the bar ACE muſt be underſtood as alſo ſaid of the bar A′ C′ E′.

Draw through the centre of the box the line *a b c* perpendicular to the line AE, BD. It is evident that the bar ACE is equivalent to a lever *a b c*, having the fulcrum or axis AE reſting with its extremity C on the pin *b g* and loaded at *b*. It is alſo evident that *a* C is to *a b* as the load on this lever to the preſſure which it exerts on the pin *g h*, and that the ſame proportion ſubſiſts between the whole load on the platform and the preſſure which it exerts on the pin *g h*. It will alſo appear, on an attentive conſideration, that this proportion is nowiſe deranged in whatever manner the load is placed on the platform. If very unequably, the two ends of the pin *g h* may be unequally preſſed, and the lever wrenched and ſtrained a little; but the total preſſure is not changed.

If there be now placed a balance or ſteelyard at the ſide LK, in ſuch a manner that one end of it may be directly above the pin *l m* in the end of the lever EOF, they may be connected by a wire or ſlender rod, and a weight on the other arm of the balance or ſteelyard may be put in equilibrio with any load that can be laid on the platform. A ſmall counterpoiſe being firſt hung on to balance the apparatus when unloaded, any additional weight will meaſure the load really laid on the platform. If *a b* be to *a c* as 1 to 8, and EO to EF alſo as 1 to 8, and if a common balance be uſed above, 64 pounds on the platform will be balanced by one pound in the ſcale, and every pound will be balanced by $\frac{1}{4}$th of an ounce. This would be a very convenient partition for moſt purpoſes, as it would enable us to uſe a common balance and common weights to complete the machine: Or it may be made with a balance of unequal arms, or with a ſteelyard. Steel-yard, Steele.

Some have thought to improve this inſtrument by uſing edges like thoſe of the nails of a balance, inſtead of points. But unleſs made with uncommon accuracy, they will render the balance very dull. The ſmall deviation of the two edges A and E, or of B and D, from perfect parallelism to KN, is equivalent to a broad ſurface equal to the whole deviation. We imagine that, with no extraordinary care, the machine may be made to weigh within $\frac{1}{1000}$th of the truth, which is exact enough for any purpoſe in commerce.

It is neceſſary that the points be attached to the bars. Some have put the points at A and E in the blocks of ſteel faſtened to the bottom, becauſe the cavity there lodged water or dirt, which ſoon deſtroyed the inſtrument with ruſt. But this occaſions a change of proportion in the firſt lever by any ſhifting of the crooked bars; and this will frequently happen when the wheels of a loaded cart are puſhed on the platform. The cavity in the ſteel ſtud ſhould have a little rim round it, and it ſhould be kept full of oil. In a nice machine a quarter of an inch of quickſilver would effectually prevent all theſe inconveniences.

The ſimpleſt and moſt economical form of this machine is to have no balance or ſecond ſteelyard; but to make the firſt ſteelyard EOF a lever of the firſt kind, viz. having the fulcrum between O and F, and allow it to project far beyond the box. The long or outward arm of this lever is then divided into a ſcale of weights, commencing at the ſide of the box. A counterpoiſe muſt be choſen, ſuch as will, when at the beginning of the ſcale, balance the ſmalleſt load that will probably be examined. It will be convenient to carry on this ſcale by means of eke-weights hung on at the *extremity* of the lever, and to uſe but one moveable weight. By this method the diviſions of the ſcale will have always one value. The beſt arrangement is as follows: Place the mark O at the beginning of the ſcale, and let it extend only to 100, if for pounds; or to 112, if for cwts.; or to 10, if for ſtones; and let the eke-weights be numbered 1, 2, 3, &c. Let the loweſt weight be marked on the beam. This is always to be added to the weight ſhown by the operation. Let the eke-weights ſtand at the end of the beam, and let the general counterpoiſe always hang at O. When the cart is put on the platform, the end of the beam tilts up. Hang on the heavieſt eke-weight that is not ſufficient to preſs it down. Now complete the balance by ſliding out the counterpoiſe. Suppoſe the conſtant load to be 312 lb. and that the counterpoiſe ſtands at 86, and that the eke-weight is 9; we have the load = 986 + 312, = 1298 lbs.

STEELE (Sir Richard), was born about the year 1676 in Dublin; in which kingdom one branch of the family was poſſeſſed of a conſiderable eſtate in the county

Steel. county of Wexford. His father, a counſellor at law in Dublin, was private ſecretary to James duke of Ormond; but he was of Engliſh extraction: and his ſon, while very young, being carried to London, he put him to ſchool at the Charter-houſe, whence he was removed to Merton College in Oxford. Our author left the univerſity, which he did without taking any degree, in the full reſolution to enter into the army. This ſtep was highly diſpleaſing to his friends; but the ardour of his paſſion for a military life rendered him deaf to any other propoſal. Not being able to procure a better ſtation, he entered as a private gentleman in the horſe guards, notwithſtanding he thereby loſt the ſucceſſion to his Iriſh eſtate. However, as he had a flow of good-nature, a generous openneſs and frankneſs of ſpirit, and a ſparkling vivacity of wit, theſe qualities rendered him the delight of the ſoldiery, and procured him an enſign's commiſſion in the guards. In the mean time, as he had made choice of a profeſſion which ſet him free from all the ordinary reſtraints in youth, he ſpared not to indulge his inclinations in the wildeſt exceſſes. Yet his gaieties and revels did not paſs without ſome cool hours of reflection; it was in theſe that he drew up his little treatiſe intitled *The Chriſtian Hero*, with a deſign, if we may believe himſelf, to be a check upon his paſſions. For this purpoſe it had lain ſome time by him, when he printed it in 1701, with a dedication to Lord Cutts, who had not only appointed him his private ſecretary, but procured for him a company in Lord Lucas's regiment of Fuſileers.

The ſame year he brought out his comedy called *The Funeral*, or *Grief à la mode*. This play procured him the regard of King William, who reſolved to give him ſome eſſential marks of his favour; and though, upon that prince's death, his hopes were diſappointed, yet, in the beginning of Queen Anne's reign, he was appointed to the profitable place of gazetteer. He owed this poſt to the friendſhip of lord Halifax and the earl of Sunderland, to whom he had been recommended by his ſchool-fellow Mr Addiſon. That gentleman alſo lent him an helping hand in promoting the comedy called *The Tender Huſband*, which was acted in 1704 with great ſucceſs. But his next play, The Lying Lover, had a very different fate. Upon this rebuff from the ſtage, he turned the ſame humorous current into another channel; and early in the year 1709, he began to publiſh the Tatler: which admirable paper was undertaken in concert with Dr Swift. His reputation was perfectly eſtabliſhed by this work; and, during the courſe of it, he was made a commiſſioner of the ſtamp-duties in 1710. Upon the change of the miniſtry the ſame year, he joined the duke of Marlborough, who had ſeveral years entertained a friendſhip for him; and upon his Grace's diſmiſſion from all employments in 1711, Mr Steele addreſſed a letter of thanks to him for the ſervices which he had done to his country. However, as our author ſtill continued to hold his place in the ſtamp-office under the new adminiſtration, he forbore entering with his pen upon political ſubjects; but, adhering more cloſely to Mr Addiſon, he dropt the Tatler, and afterwards, by the aſſiſtance chiefly of that ſteady friend, he carried on the ſame plan much improved, under the title of *The Spectator*. The ſucceſs of this paper was equal to that of the former; which encouraged him, before the cloſe of it, to proceed upon the ſame deſign in the character of the *Guardian*. This was opened in the beginning of the year 1713, and was laid down in October the ſame year. But in the courſe of it his thoughts took a ſtronger turn to politics: he engaged with great warmth againſt the miniſtry; and being determined to proſecute his views that way by procuring a ſeat in the houſe of commons, he immediately removed all obſtacles thereto. For that purpoſe he took care to prevent a forcible diſmiſſion from his poſt in the ſtamp office, by a timely reſignation of it to the Earl of Oxford; and at the ſame time gave up a penſion, which had been till this time paid him by the queen as a ſervant to the late prince George of Denmark. This done, he wrote the famous Guardian upon the demolition of Dunkirk, which was publiſhed Aug. 7. 1713; and the parliament being diſſolved next day, the Guardian was ſoon followed by ſeveral other warm political tracts againſt the adminiſtration. Upon the meeting of the new parliament, Mr Steele having been returned a member for the borough of Stockbridge in Dorſetſhire, took his ſeat accordingly in the houſe of commons; but was expelled thence in a few days after, for writing the cloſe of the paper called the *Engliſhman*, and one of his political pieces intitled the *Criſis*. Preſently after his expulſion, he publiſhed propoſals for writing the hiſtory of the duke of Marlborough: at the ſame time he alſo wrote the *Spinſter*; and, in oppoſition to the *Examiner*, he ſet up a paper called the *Reader*, and continued publiſhing ſeveral other things in the ſame ſpirit till the death of the queen. Immediately after which, as a reward for theſe ſervices, he was taken into favour by her ſucceſſor to the throne, king George I. He was appointed ſurveyor of the royal ſtables at Hampton-Court, governor of the royal company of comedians, put into the commiſſion of the peace for the county of Middleſex, and in 1715 received the honour of knighthood. In the firſt parliament of that king, he was choſen member for Boroughbridge in Yorkſhire; and, after the ſuppreſſion of the rebellion in the north, was appointed one of the commiſſioners of the forfeited eſtates in Scotland. In 1718, he buried his ſecond wife, who had brought him a handſome fortune and a good eſtate in Wales; but neither that, nor the ample additions lately made to his income, were ſufficient to anſwer his demands. The thoughtleſs vivacity of his ſpirit often reduced him to little ſhifts of wit for its ſupport; and the project of the Fiſh-pool this year owed its birth chiefly to the projector's neceſſities. This veſſel was intended to carry fiſh alive, and without waſting, to any part of the kingdom: but notwithſtanding all his towering hopes, the ſcheme proved very ruinous to him; for after he had been at an immenſe expence in contriving and building his veſſel, beſides the charge of the patent, which he had procured, it turned out upon trial to be a mere project. His plan was to bring ſalmon alive from the coaſt of Ireland; but theſe fiſh, though ſupplied by this contrivance with a continual ſtream of water while at ſea, yet uneaſy at their confinement, ſhattered themſelves to pieces againſt the ſides of the pool; ſo that when they were brought to market they were worth very little.

Steele. The following year he oppoſed the remarkable peerage bill in the houſe of commons; and, during the

Steele.

course of this opposition to the court, his licence for acting plays was revoked, and his patent rendered ineffectual, at the instance of the lord chamberlain. He did his utmost to prevent so great a loss; and finding every direct avenue of approach to his royal master effectually barred against him by his powerful adversary, he had recourse to the method of applying to the public, in hopes that his complaints would reach the ear of his sovereign, though in an indirect course, by that canal. In this spirit he formed the plan of a periodical paper, to be published twice a-week, under the title of the *Theatre*; the first number of which came out on the 2d of January 1719-20. In the mean time, the misfortune of being out of favour at court, like other misfortunes, drew after it a train of more. During the course of this paper, in which he had assumed the feigned name of *Sir John Edgar*, he was outrageously attacked by Mr Dennis, the noted critic, in a very abusive pamphlet, intitled *The Character and Conduct of Sir John Edgar*. To this insult our author made a proper reply in the Theatre.

While he was struggling with all his might to save himself from ruin, he found time to turn his pen against the mischievous South-Sea scheme, which had nearly brought the nation to ruin in 1720; and the next year he was restored to his office and authority in the playhouse in Drury-Lane. Of this it was not long before he made an additional advantage, by bringing his celebrated comedy called the *Conscious Lovers* upon that stage, where it was acted with prodigious success; so that the receipt there must have been very considerable, besides the profits accruing by the sale of the copy, and a purse of 500l. given to him by the king, to whom he dedicated it. Yet notwithstanding these ample supplies, about the year following, being reduced to the utmost extremity, he sold his share in the play-house; and soon after commenced a law-suit with the managers, which in 1726 was determined to his disadvantage. Having now again, for the last time, brought his fortune, by the most heedless profusion, into a desperate condition, he was rendered altogether incapable of retrieving the loss, by being seized with a paralytic disorder, which greatly impaired his understanding. In these unhappy circumstances, he retired to his seat at Languanor near Caermarthen in Wales, where he paid the last debt to nature on the 21st of September 1729, and was privately interred, according to his own desire, in the church of Caermarthen. Among his papers were found the manuscripts of two plays, one called *The Gentleman*, founded upon the eunuch of Terence, and the other intitled *The School of Action*, both nearly finished.

Sir Richard was a man of undissembled and extensive benevolence, a friend to the friendless, and, as far as his circumstances would permit, the father of every orphan. His works are chaste and manly. He was a stranger to the most distant appearance of envy or malevolence; never jealous of any man's growing reputation; and so far from arrogating any praise to himself from his conjunction with Mr Addison, that he was the first who desired him to distinguish his papers. His greatest error was want of economy: however, he was certainly the most agreeable, and (if we may be allowed the expression) the most innocent rake that ever trod the rounds of dissipation.

Steeple, || Steering.

STEEPLE, an appendage erected generally on the western end of churches, to hold the bells. Steeples are denominated from their form, either spires or towers: the first are such as ascend continually diminishing either conically or pyramidally; the latter are mere parallelopipeds, and are covered a-top platform-like.

STEERAGE, on board a ship, that part of the ship next below the quarter-deck, before the bulk-head of the great cabin where the steersman stands, in most ships of war. See STEERING.

STEERING, in navigation, the art of directing the ship's way by the movements of the helm; or of applying its efforts to regulate her course when she advances.

The perfection of steering consists in a vigilant attention to the motion of the ship's head, so as to check every deviation from the line of her course in the first instant of its motion; and in applying as little of the power of the helm as possible. By this she will run more uniformly in a straight path, as declining less to the right and left; whereas, if a greater effort of the helm is employed, it will produce a greater declination from the course, and not only increase the difficulty of steering, but also make a crooked and irregular tract through the water. See HELM.—The helmsman should diligently watch the movements of the head by the land, clouds, moon, or stars; because, although the course is in general regulated by the compass, yet the vibrations of the needle are not so quickly perceived as the sallies of the ship's head to the right or left, which, if not immediately restrained, will acquire additional velocity in every instant of their motion, and demand a more powerful impulse of the helm to reduce them; the application of which will operate to turn her head as far on the contrary side of her course. —The phrases used in steering a ship vary according to the relation of the wind to her course. Thus, if the wind is fair or large, the phrases used by the pilot or officer who superintends the steerage are, *port*, *starboard*, and *steddy*. The first is intended to direct the ship's course farther to the right; the second is to guide her farther to the left; and the last is designed to keep her exactly in the line whereon she advances, according to the course prescribed. The excess of the first and second movement is called *hard-a-port*, and *hard-a-starboard*; the former of which gives her the greatest possible inclination to the right, and the latter an equal tendency to the left.—If, on the contrary, the wind is foul or scant, the phrases are *luff*, *thus*, and *no nearer*: the first of which is the order to keep her close to the wind; the second, to retain her in her present situation; and the third, to keep her sails full.

In a ship of war, the exercise of steering the ship is usually divided amongst a number of the most expert sailors, who attend the helm in their turns; and are accordingly called *timoneers*, from the French term *timonier*, which signifies "helmsman." The steerage is constantly supervised by the quarter-masters, who also attend the helm by rotation. In merchant-ships every seaman takes his turn in this service, being directed therein by the mate of the watch, or some other officer. —As the safety of a ship, and all contained therein, depends in a great measure on the steerage or effects of the helm, the apparatus by which it is managed should often be diligently examined by the proper officers. Indeed,

Steganium || Stem.

deed, a negligence in this important duty appears almoſt unpardonable, when the fatal effects which may reſult from it are duly conſidered.

STEGANIUM. See SLATE.

STEGANOGRAPHY, the art of ſecret writing, or of writing in ciphers, known only to the perſons correſponding. See CIPHER.

STELLARIA, STICHWORT, in botany: A genus of plants belonging to the claſs of *decandria*, and order of *trigynia*; and in the natural ſyſtem arranged under the 22d order, *Caryophylleæ*. The calyx is pentaphyllous and ſpreading. There are five petals, each divided into two ſegments. The capſule is oval, unilocular, and polyſpermous. There are nine ſpecies, the nemorum, dichotoma, radians, holoſtea, graminea, ceraſtoides, undulata, biflora, and arenaria. Three of theſe are Britiſh plants. 1. *Nemorum*, broad-leaved ſtichwort. The ſtalks are about a foot or eighteen inches high, and branched in a panicle at the top. The leaves are heart-ſhaped, and of a paler green on the under than on the upper ſide; the lower ones being ſupported by foot-ſtalks which are hairy and channelled; the upper ones are ſeſſile. The calyx is erect, ſomewhat hairy and white on the margins. The petals are bifid almoſt to the baſe. There is a ſmall nectarium between the longer ſtamina and the calyx.—2. *Holoſtea*, greater ſtichwort. The ſtalks are about two feet long; the petals are nearly twice the length of the calyx, and divided half-way to the baſe. It is common in woods and hedges.—3. *Graminea*, leſs ſtichwort. The ſtem is near a foot high. The leaves are linear and entire, and the flowers grow in looſe panicles. It is frequent in dry paſtures. There is a variety of this ſpecies called *bog ſtichwort*, with ſmooth, oval, ſeſſile leaves, and few leaves, which grows often in wet marſhy places. The ſtalk is quadrangular; the petals ſcarcely longer than the calyx, and bifid to the baſe.

STELLATE, among botaniſts, expreſſes leaves which grow not leſs than ſix at a joint, and are arranged like the rays of a ſtar.

STELLERA, GERMAN GROUNDSEL, in botany: A genus of plants belonging to the claſs of *octandria*, and order of *monogynia*; and in the natural ſyſtem arranged under the 31ſt order, *Vepreculæ*. There is no calyx. The corolla is quadrifid. The ſtamina are very ſhort. There is only one ſeed, which is black. The ſpecies are two in number, paſſerina and chamaejaſme.

STELLIONATE, in the civil law, a kind of crime committed by a fraudulent bargain, where one of the parties ſells a thing for what it is not; as if I ſell an eſtate for my own which belongs to another, or convey a thing as free and clear which is already engaged to another, or put off copper for gold, &c.

STEM, in botany, that part of a plant ariſing out of the root, and which ſuſtains the leaves, flowers, fruits, &c. By waſhing and rubbing the ſtems of trees, their annual increaſe is promoted; for the method of doing which, ſee the article TREE.

Stem || Stemſon.

STEM of a Ship, a circular piece of timber into which the two ſides of a ſhip are united at the fore-end: the lower end of it is ſcarfed to the keel, and the bowſprit reſts upon its upper end. The ſtem is formed of one or two pieces, according to the ſize of the veſſel; and as it terminates the ſhip forward, the ends of the wales and planks of the ſides and bottom are let into a groove or channel, in the midſt of its ſurface, from the top to the bottom; which operation is called *rabiting*. The outſide of the ſtem is uſually marked with a ſcale, or diviſion of feet, according to its perpendicular height from the keel. The intention of this is to aſcertain the draught of water at the fore-part, when the ſhip is in preparation for a ſea-voyage, &c. The ſtem at its lower end is of equal breadth and thickneſs with the keel, but it grows proportionally broader and thicker towards its upper extremity. See *SHIP-Building*.

STEMMATA, in the hiſtory of inſects, are three ſmooth hemiſpheric dots, placed generally on the top of the head, as in moſt of the hymenoptera and other claſſes. The name was firſt introduced by Linnæus.

STEMODIA, in botany: A genus of plants belonging to the claſs of *didynamia*, and order of *angioſpermia*; and in the natural ſyſtem ranging under the 40th order, *Perſonatæ*. The calyx is quinquepartite; the corolla bilabiated; there are four ſtamina; each of the filaments are bifid, and have two antheræ. The capſule is bilocular. There is only one ſpecies, the maritima.

STEMPHYLA, a word uſed by the ancients to expreſs the huſks of grapes, or the remains of the preſſings of wine. The ſame word is alſo uſed by ſome to expreſs the remaining maſs of the olives, after the oil is preſſed out.

STEMPHYLITES, a name given by the ancients to a ſort of wine preſſed hard from the huſks.

STEMPLES, in mining, croſs bars of wood in the ſhafts which are ſunk to mines.

In many places the way is to ſink a perpendicular hole, or ſhaft, the ſides of which they ſtrengthen from top to bottom with wood-work, to prevent the earth from falling in: the tranſverſe pieces of wood uſed to this purpoſe they call *ſtemples*, and by means of theſe the miners in ſome places deſcend, without uſing any rope, catching hold of theſe with their hands and feet.

STEMSON, in a ſhip, an arching piece of timber fixed within the apron, to reinforce the ſcarf thereof, in the ſame manner as the apron ſupports the ſcarf of the ſtern. In large ſhips it is uſually formed of two pieces.

STEELYARD.

Fig. 4.

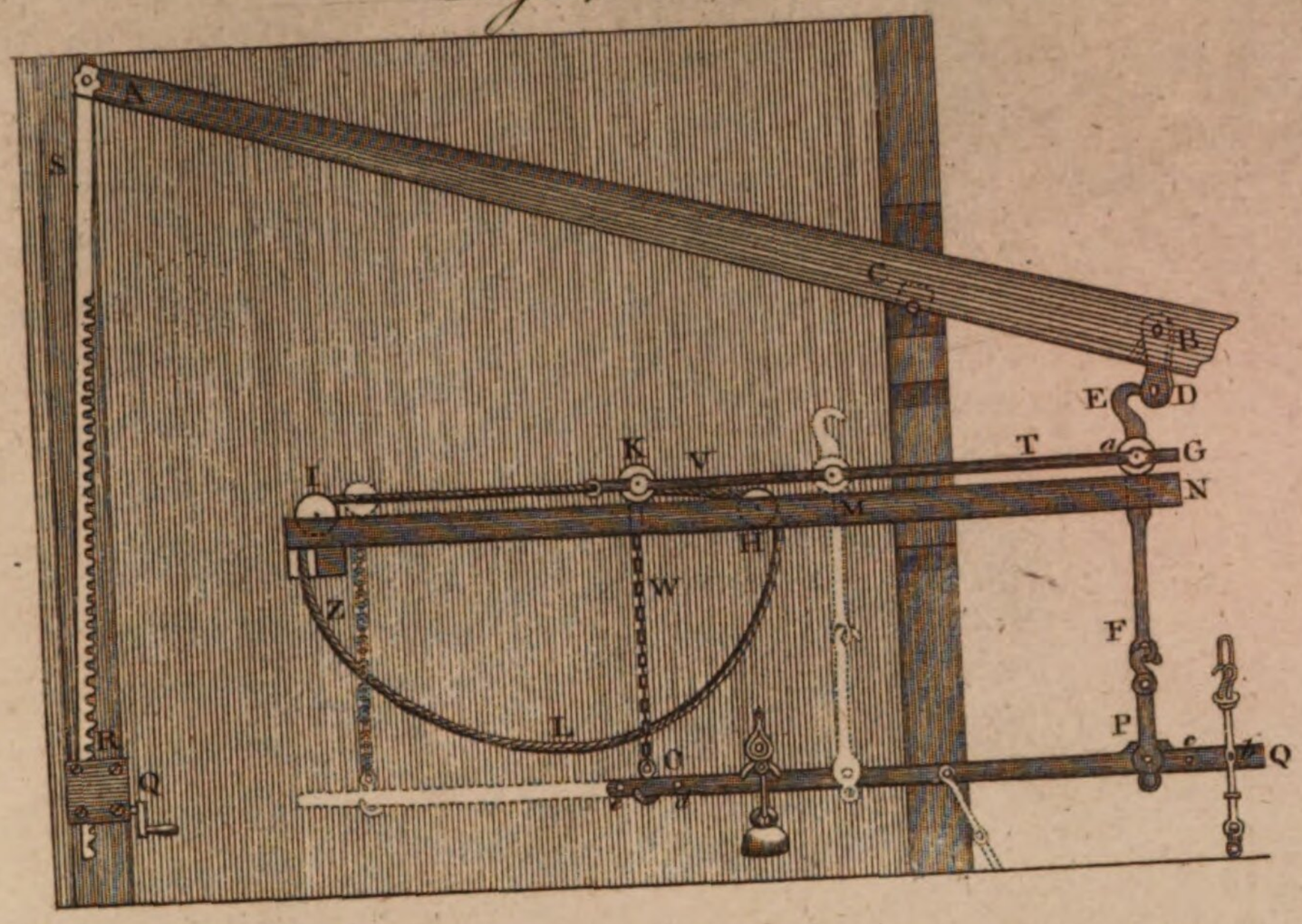


Fig. 2.

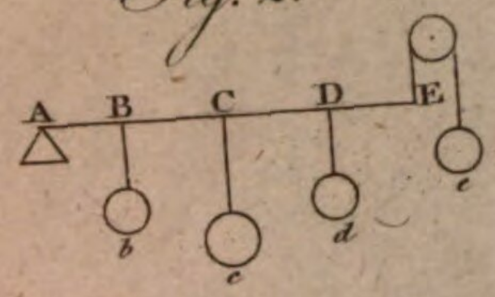
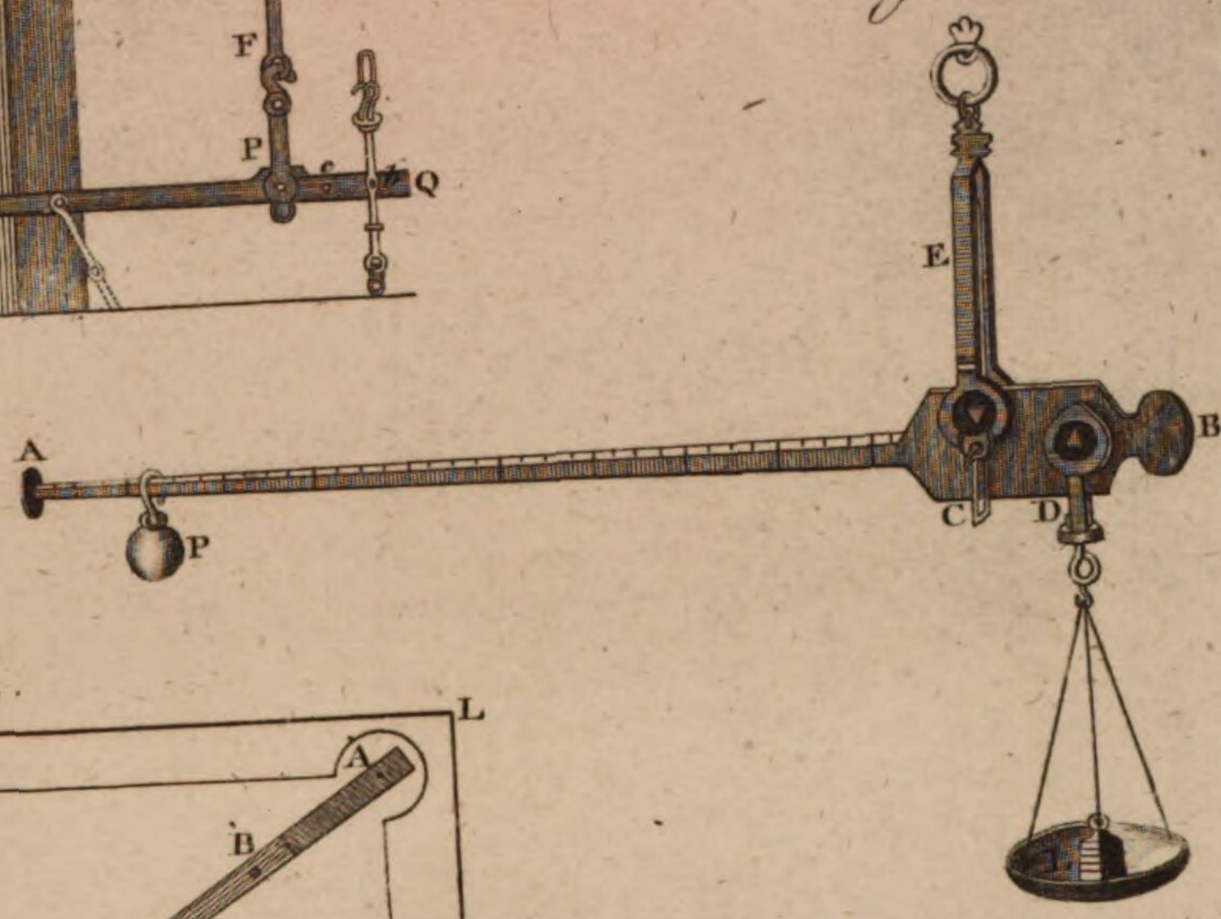


Fig. 1.



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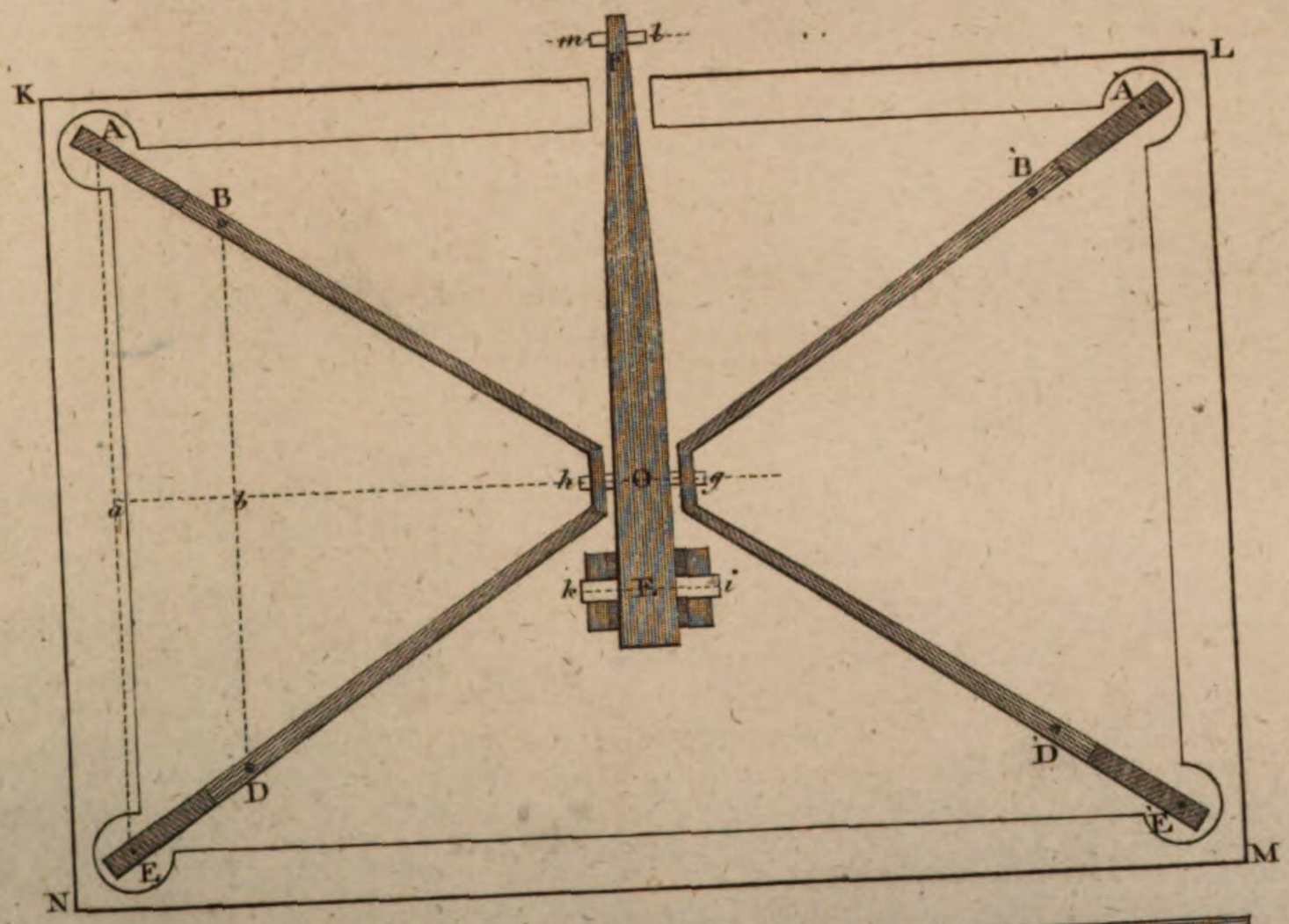


Fig. 3.

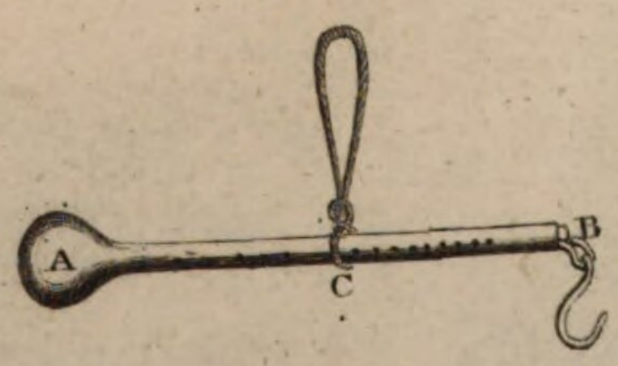
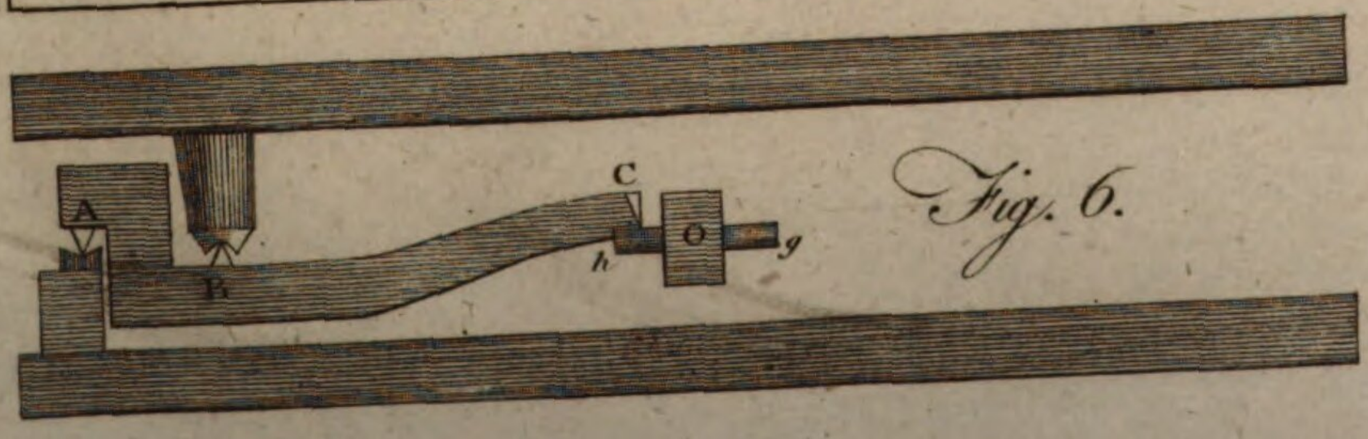


Fig. 6.



A. Bell Print. Wal. Sculptor fecit.

STENOGRAPHY (A).

CHAP. I.

THE art of ſtenography, or ſhort writing, was known and practiſed by moſt of the ancient civilized nations. The Egyptians, who were diſtinguiſhed for learning at an early period, at firſt expreſſed their words by a delineation of figures called *hieroglyphics*, A more conciſe mode of writing ſeems to have been afterwards introduced, in which only a part of the ſymbol or picture was drawn. This anſwered the purpoſe of ſhort-hand in ſome degree. After them the Hebrews, the Greeks, and the Romans *, adopted different methods of abbreviating their words and ſentences, ſuited to their reſpective languages. The initials, the finals, or radicals, often ſerved for whole words; and various combinations of theſe ſometimes formed a ſentence. Arbitrary marks were likewiſe employed to determine the meaning, and to aſſiſt legibility; and it ſeems probable that every writer, and every author of antiquity, had ſome peculiar method of abbreviation, calculated to facilitate the expreſſion of his own ſentiments, and intelligible only to himſelf.

* Vide *Buxtorf, Diog. Laertius, Plutarch, &c.*

It is alſo probable, that ſome might by theſe means take down the heads of a diſcourſe or oration; but few, very few, it is preſumed, could have followed a ſpeaker through all the meanders of rhetoric, and noted with preciſion every ſyllable, as it dropt from his mouth, in a manner legible even to themſelves.

To arrive at ſuch conſummate perfection in the art was reſerved for more modern times, and is ſtill an acquiſition by no means general.

In every language of Europe, till about the cloſe of the 16th century, the Roman plan of abbreviating (viz. ſubſtituting the initials or radicals, with the help of arbitraries, for words) appears to have been employed. Till then no regular alphabet had been invented expreſsly for ſtenography, when an Engliſh gentleman of the name of *Willis* invented and publiſhed one (B). His plan was ſoon altered and improved, or at leaſt pretended to be ſo. One alteration ſucceeded another; and at intervals, for a ſeries of years paſt, ſome men of ingenuity and application have compoſed and publiſhed ſyſtems of ſtenography, and doubtleſs have themſelves reaped all the advantages that attend it. But among the various methods that have been propoſed, and the different plans that have been adopted by individuals, none has yet appeared fortunate enough to gain general approbation; or proved ſufficiently ſimple, clear, and conciſe, to be univerſally ſtudied and practiſed.

Some ſyſtems are replete with unmeaning ſymbols, perplexing arbitraries, and ill-judged contractions; which render them ſo difficult to be attained by a common capacity, or ordinary application, that it is not to be wondered at if they have ſunk into neglect, and are now no longer known (C). Other ſyſtems, by being too prolix, by containing a multiplicity of characters, and thoſe characters not ſimple or eaſily remembered, become ineffectual to the purpoſe of expedition, and are only ſuperior in obſcurity to a common hand. Some, again, not only reject all arbitraries and contractions, but even prepoſitions and terminations; which laſt, if not too laviſhly employed and badly deviſed, highly contribute to promote both expedition and legibility; and though they reduce their characters to fewer than can poſſibly expreſs the various modifications of ſound, yet they make nearly one half of them complex. In the diſpoſition of the vowels, there is the greateſt perplexity in moſt ſyſtems. A dot is ſometimes ſubſtituted for all the vowels indiſcriminately, and the judgment is left to determine which letter out of ſix any dot is intended to expreſs; or a minute ſpace is allotted them; ſo that unleſs they be arranged with mathematical preciſion they cannot be diſtinguiſhed from one another; but ſuch a minute attention is inconſiſtent with the nature of ſhort-hand, which ſhould teach us to write down in a ſhort time, as well as in ſmall bounds, what we wiſh to preſerve of what we hear. Nor is the plan of lifting the pen and putting the next conſonant in the vowel's place, in the middle of words, leſs liable to objections; or that of repreſenting all the vowels by diſtinct characters, being obviouſly ill calculated for facility and diſpatch, and conſequently inadmiſſible into any uſeful ſyſtem.

It is to be confeſſed, that the perſon who firſt propoſed

(A) The value of ſtenography is not unknown to the learned; and the care and ſucceſs with which it has been lately cultivated in theſe kingdoms will, in all probability, ſoon render it an object of general attention. No one, however, appears to us to have ſimplified and improved the art ſo much as Dr Mavor, author of *Univerſal Stenography*, who has liberally permitted us to preſent our readers with a complete view of his ſcheme. To thoſe who wiſh to become proficients in SHORT-WRITING, we earneſtly recommend his entire publication (printed for Cadell and Davis, Strand, London), which in many ſchools of the firſt reputation now forms a deſerved claſs book.

(B) Mr Locke ſays, a regular method of ſhort-writing ſeems to be known and practiſed only in Britain. This is not now the caſe; and indeed there is no reaſon to doubt whether characters may not be invented to expreſs the various ſounds, or letters, employed in any language, either ancient or modern.

(C) A liſt of writers on ſtenography. Mr Addy, Aldridge, Angell, Annet, Blandemore, Bloſſet, Botley, Bridges, Byrom, Coles, Croſs, Dix, Everardt, Ewen, Facey, Farthing, Gibbs, Græme, Gurney, Heath, Holdſworth, Hopkins, Jeake, Labourer, Lane, Lyle, Macauley, Maſon, Mavor, Metcalfe, Nicholas, Palmer, Rich, Ridpath, Shelton, Steele, Tanner, Taylor, Thickneſſe, Tiffen, Webſter, Weſton, Williamſon, Willis, B. D. and Willis, &c.

poſed the omiſſion of vowels in the middle of words (D), which it is obvious are not wanted, and invented letters, which could be connected as in a running hand without lifting the pen in the middle of the word, made a real improvement on the works of his predeceſſors. But, in fine, moſt ſyſtems, either in their plan or execution, labour under ſome capital defect, attended with circumſtances highly diſcouraging to the learner, and which in a great meaſure defeat the end of their invention, by being too complicated to be learned with eaſe and remembered with accuracy, or to be practiſed with the expedition which is requiſite; and ſo difficult to be deciphered, that a man can ſcarcely read what he has juſt written.

To obviate theſe defects; to provide againſt prolixity and conciſeneſs, which might occaſion obſcurity; to exhibit a ſyſtem founded on the ſimpleſt principles, which might be eaſily learned and read, and yet be capable of the utmoſt expedition—were the motives that gave riſe to the preſent attempt.

This method will be found different from any yet publiſhed, and ſuperior to all in the diſpoſition of the vowels and the facility of arranging them; the confuſion in placing which ſeems to detract from the merit of the beſt performances on the ſubject; and it may be affirmed, without oſtentation, that characters ſimpler in their form, and more perfect in their union, have not been applied to the art of ſtenography.

As well as it could be determined, the ſimpleſt characters are appropriated to the letters moſt uſually employed: indeed, as far as poſſible, thoſe which are complex have been rejected; but as it was an object always kept in view that the writing ſhould be on a line, a few are admitted into the alphabet for that reaſon.

The characters for the double and triple conſonants are the eaſieſt that could be invented, conſiſtent with perſpicuity (E); for care has been taken to provide againſt all obſcurity which might ariſe by adopting letters too ſimilar in their formation; and with reſpect to the prepoſitions and terminations, thoſe which occur moſt frequently are expreſſed by the ſimpleſt characters, which will be found perfectly eaſy in their application.

The arbitraries are few in number (F), and the arbitrary abbreviations, as they are entirely from the letters of the alphabet, and choſen from ſome thouſands of words in common uſe, will well repay the learner for an hour's trouble in committing them to memory.

The laſt chapter lays down a ſcheme of abbreviation, compriſed in a few rules, perfectly eaſy to be underſtood and practiſed by proficients in this art, which we hope will anſwer the expectation of the author, and will be found free from the perplexity complained of in many ſyſtems where abbreviation is admitted. The principal rules are new, are ſo eaſy, ſo extenſive in their uſe, and ſo conſiſtent with expedition and legibility, if applied with judgment, that they alone might ſuffice. The learner is however adviſed by no means to adopt any of them, till experience has convinced him that they may be uſed without error or injury to legibility. All abbreviating rules are ſuited to thoſe only who have made ſome progreſs in the ſtenographic art; for although they certainly promote expedition in a wonderful manner, and afford the greateſt eaſe to a proficient, yet a learner, as expedition is not his firſt, though his ultimate view, ſhould admit of nothing that in the leaſt renders the reading difficult.

CHAP. II.

THE Engliſh alphabet conſiſts of twenty-ſix letters; ſix of which are vowels, *a*, *e*, *i*, *o*, *u*, and *y*; and the other twenty conſonants, *b*, *c*, *d*, *f*, *g*, *h*, *j*, *k*, *l*, *m*, *n*, *p*, *q*, *r*, *s*, *t*, *v*, *w*, *x*, and *z*. I The general principles of ſtenography.

This alphabet, as is obſerved by the beſt grammarians that have written on the language, is both defective and redundant in expreſſing the various modifications of ſound *.

Cuſtom or prejudice has aſſigned ſome letters a place, when others would with much more propriety expreſs the ſame ſound: and to this may be added, that ſeveral letters, ſometimes in one word, ſeem to be admitted for no other reaſon than to perplex a young beginner or a foreigner, as an obſtruction to true pronunciation, and to add to the apparent length of the word, when they are entirely quieſcent and uſeleſs. That this is the genius of the orthography of our language muſt be perceived by the moſt ſuperficial obſerver; but no modern tongue is abſolutely free from the ſame exceptions. In particular, the French has a great number of dormant letters, which, it is obvious, render the pronunciation more difficult and perplexing to learners (G).

* *Lowth's Gram. Prieſtley's Gram. Sheridan's Lectures on Elocution.*

But as it is neither our buſineſs nor our intention to propoſe a mode of ſpelling different from that in common uſe, when applied to printing or long-hand writing (ſince ſeveral innovators in orthography have fallen into contempt, and their plans have been only preſerved as beacons to warn others of the folly of endeavouring to ſubvert eſtabliſhed principles §); we ſhall only obſerve, that in ſtenography, where the moſt expeditious and conciſe method is the beſt, if conſiſtent with perſpicuity, the following ſimple rules are ſtudiouſly to be regarded and practiſed.

§ *Preface to Johnſon's Dictionary.*

RULE I. All quieſcent conſonants in words are to be

(D) Mr Byrom rejected vowels entirely in the middle of words, as others before him had only done partially. Without critically examining the executive part of his performance, which is very defective, it muſt be owned, that it is above the reach of human ingenuity to exceed his general plan; which for ever muſt be the baſis of every future rational ſyſtem.

(E) Thoſe for *th* and *ch* may be either made upright or ſloping to the right.

(F) Theſe are not by any means preſcribed; they may be employed or not according to the fancy of the learner.

(G) The Latin and Greek claim a juſt ſuperiority over every modern tongue in this reſpect. In them no confuſion or doubt can ariſe from the manner of ſpelling; and the reader can ſcarcely be wrong (unleſs in quantity) in ſounding all the letters he ſees.

2 Rules for the conſonants.

be dropped; and the orthography to be directed only by the pronunciation: which being known to all, will render this art attainable by thoſe who cannot ſpell with preciſion in long hand.

Rule II. When the abſence of conſonants, not entirely dormant, can be eaſily known, they may often be omitted without the leaſt obſcurity.

Rule III. Two or ſometimes more conſonants may, to promote greater expedition, be exchanged for a ſingle one of nearly ſimilar ſound; and no ambiguity as to the meaning enſue (H).

Rule IV. When two conſonants of the ſame kind or ſame ſound come together, without any vowel between them, only one is to be expreſſed; but if a vowel or vowels intervene, both are to be written: only obſerve, if they are perpendicular, horizontal, or oblique lines, they muſt only be drawn a ſize longer than uſual; and characters with loops muſt have the ſize of their heads doubled ‖.

‖ Vide Plate cccclxxxii.

3 Firſt rule exemplified.

Might is to be written *mit*, fight *fit*, machine *maſhin*, enough *enuf*, laugh *laf*, prophet *profet*, phyſics *fiſiks*, through *thro'*, foreign *foren*, ſovereign *ſoveren*, pſalm *ſam*, receipt *reſet*, write *rite*, wright *rit*, iſland *iland*, knavery *navery*, temptation *temtation*, knife *nife*, ſtick *ſtik*, thigh *thi*, honour *onour*, indictment *inditement*, acquaint *aquaint*, chaos *kaos*, &c.

4 Second rule exemplified.

Strength *ſtrenth*, length *lenth*, friendſhip *frenſhip*, connect *conek*, commandment *comanment*, conjunct *conjunt*, humble *humle*, lumber *lumer*, ſlumber *ſlumer*, number *numer*, exemplary *exemlary*, &c.

5 Third rule exemplified.

Rocks *rox*, acts *aks* or *ax*, facts *faks* or *fax*, diſtricts *diſtriks* or *diſtrix*, affects *afeks* or *afex*, afflicts *afliks* or *aflix*, conquer *konkr*, &c.

6 Fourth rule exemplified.

Letter *leter*, little *litle*, command *comand*, error *eror*, terror *teror*, &c. But in *remember*, *moment*, *ſiſter*, and ſuch like words, where two conſonants of the ſame name have an intervening vowel, both of them muſt be written.

Theſe four rules, with their examples, being carefully conſidered by the learner, will leave him in no doubt concerning the diſpoſition and management of the conſonants in this ſcheme of ſhort-writing; we ſhall therefore proceed to lay down rules for the application of the vowels with eaſe and expedition.

7 Rules for the vowels

Rule I. Vowels, being only ſimple articulate ſounds, though they are the connectives of conſonants, and employed in every word and every ſyllable, are not neceſſary to be inſerted in the middle of words; becauſe the conſonants, if fully pronounced, with the aſſiſtance of connection, will always diſcover the meaning of a word, and make the writing perfectly legible.

Rule II. If a vowel is not ſtrongly accented in the incipient ſyllable of a word, or if it is mute in the final, it is likewiſe to be omitted; becauſe the ſound of the incipient vowel is often implied in that of the firſt conſonant, which will conſequently ſupply its place.

Rule III. But if the vowel conſtitutes the firſt or laſt ſyllable of a word, or is ſtrongly accented at its beginning or end, that vowel is continually to be written.

Rule IV. If a word begins or ends with two or more vowels though ſeparated, or when there is a coalition of vowels, as in dipthongs and tripthongs; only one of them is to be expreſſed, which muſt be that which agrees beſt with the pronunciation.

Rule V. In monoſyllables, if they begin or end with a vowel, it is always to be inſerted, unleſs the vowel be *e* mute at the end of a word.

Such are the general principles of this art; in vindication and ſupport of which it will be needleſs to offer any arguments, when it is conſidered that brevity and expedition are the chief objects, if conſiſtent with legibility; and the ſubſequent ſpecimens in the orthography recommended will, we hope, be ſufficient to ſhow that there is no real deficiency in the laſt mentioned particular.

8 Specimen of the mode of ſpelling in ſtenography.

He who md us mſt be etrnl, grt, nd mnptnt. It is ur dty, as rſnl bngs, to ſrv, lv, nd oby hm.—A mn tht wd avd blm, ſhd be ſrkmſpk in al hs axns, nd ndvr wth al hs mt to pls evry bdy.—I wd nt frm any knxns wth a mn who hd no rgrd fr hmſlf; nthr wd I blv a mn who hd ons tld me a li.—Onr is of al thngs the mſt dfklt to prſrv ntrnſhd; nd whn ons mpchd, lk the chſtty of a wmn, nvr ſhns wth its wntd lſtr.—Wth gd mnrs, kmplſns nd an eſy plt adrs, mny mk a ſgr in the wrl, whs mntl ablts wd ſkrſly hv rsd thm abv the rnk of a ſtmn.—Idlns is the prnt of a thſnd msfrtns, wch ar nvr flt by the ndſtrs: it is a pn nd a pnſhmnt of itslf, nd brngs wnt nd bgry in its trn.—Vrtu is the frſt thng tht ſhd be rgrdd; it is a rwrd of itslf; mks a mn rſpktbl hr, nd wl mk hm etrnly hpy hrfter.—Prd is a mſt prnſs psn, wch yt ws plntd by hvn in ur ntr, to rs ur emlsn to imtt grt nd wrthy krktrs or axns, to xt in us a sl fr wht is rt nd gſt, nd a ldbl ndgnſn gnſt oprſrs nd wrkrs of any knd of nkty; in ſhrt, to mk us st a prpr vlu upn urſlvs, nd dſps a wrthls flo, hu evr xltd. Ths fr prd is a vrtu, nd my gſtly be kld a grtns of ſl. Bt prd, lk othr pſns, gnrly fxs upn rng obgks, or is apld in rng prprſns. Hu kmn is it to ſe a rtch whm evry vs hs rndrd mſrbl, nd evry fly kntmtbl, vlng hmſlf on hs hi brth, nd bſtng ths ilſtrs nſſttrs, of whm he nhrts nthng bt the nm or ttl! nſſtrs who if thy nu hm, wd dſn thr dpndnt wth kntmt. But al prd of ths frt is fly, nd evr to be avdd.

CHAP. III.

As the whole of this art depends upon a regular method and a ſimple alphabet, we have not only endeavoured to eſtabliſh the former on ſatisfactory principles, but have been careful to appropriate, according to the comparative frequency of their occurrence, ſuch characters for the letters as, after repeated trials and alterations, were conceived to be the beſt adapted for diſpatch.

9 Stenographic alphabet.

The ſtenographic alphabet conſiſts of 18 diſtinct characters (viz. two for the vowels and the reſt for the conſonants), taken from lines and ſemicircular curves; the formation and application of which we ſhall now explain, beginning with the vowels.

For the three firſt vowels, *a*, *e*, and *i*, a comma is appropriated

(H) By this rule likewiſe *q* and *v* in the middle of words, but never in the beginning, may be exchanged for *k* and *f*, when they admit of an eaſier connection with the following character, or will make the writing appear neater.

propriated in different positions; and for the other three, *o*, *u*, and *y*, a point. The comma and point, when applied to *a* and *o*, is to be placed, as in Plate CCCCLXXXII. at the top of the next character; when for *e* and *u*, opposite to the middle; and when for *i* and *y*, at the bottom.

This arrangement of the vowels is the most simple and distinct that can easily be imagined. Places at the top, the middle, and the bottom of characters, which make three different positions, are as easily distinguished from one another as any three separate characters could be; and a comma is made with the same facility as a point.

10 Lines. Simple lines may be drawn four different ways; perpendicular, horizontal, and with an angle of about 45 degrees to the right and left. An ascending oblique line to the right, which will be perfectly distinct from the rest when joined to any other character, may likewise be admitted. These characters being the simplest in nature, are assigned to those five consonants which most frequently occur, viz. *l*, *r*, *t*, *c* hard or *k*, and *c* soft or *s*.

11 Circles. Every circle may be divided with a perpendicular and horizontal line, so as to form likewise four distinct characters. These being the next to lines in the simplicity of their formation, we have appropriated them for *b*, *d*, *n*, and *m*.

12 Curves and lines. The characters expressing nine of the consonants are all perfectly distinct from one another; eight only remain which are needful, viz. *f*, *g* or *j*, *h*, *p*, *q*, *v*, *w*, and *x*. To find characters for which we must have recourse to mixed curves and lines. The characters which we have adopted are the simplest in nature after those already applied, admit of the easiest joining, and tend to preserve lineality and beauty in the writing.

It must be observed that we have no character for *c* when it has a hard sound, as in *castle*; or soft, as in *city*; for it naturally takes the sound of *k* or *s*, which in all cases will be sufficient to supply its place.

R likewise is represented by the same character as *l*; only with this difference, *r* is written with an ascending stroke (I), and *l* with a descending; which is always to be known from the manner of its union with the following character; but in a few monosyllables where *r* is the only consonant in the word, and consequently stands alone, it is to be made as is shown in the alphabet for distinction's sake.

Z, as it is a letter seldom employed in the English language, and only a coarser and harder expression of *s*, must be supplied by *s* whenever it occurs; as for *Zedekiah* write *Sedekiah*, &c.

CHAP. IV.

The prepositions and terminations in this scheme are so simple, that the greatest benefit may be reaped from them, and very little trouble required to attain them; as the incipient letter or the incipient consonant of all the prepositions and of several of the terminations is used to express the whole. But although in Plate CCCCLXXXII. sufficient specimens are given of the manner of their application, that the learner of less ingenuity or more slow perception may have every assistance, we have subjoined the following directions. 13 Rules for prepositions and terminations.

Rule I. The preposition is always to be written without joining, yet so near as plainly to show what word it belongs to; and the best way is to observe the same order as if the whole was to be connected.

Rule II. A preposition, though the same letters that constitute it may be met with in the middle or end of a word, is never to be used, because it would expose to obscurity.

Rule III. Observe that the preposition *omni* is expressed by the vowel *o* in its proper position; and for *anti*, *anta*, *ante*, by the vowel *a*, which the radical part of the word will easily distinguish from being only simple vowels.

The first rule for the prepositions is (allowing such exceptions as may be seen in the Plate) to be observed for the terminations; and also the second *mutatis mutandis*; except that whenever *sis*, *sus*, *sys*, *cious*, *tious*, and *ces* occur, they are to be expressed as directed in the fourth rule for the consonants, whether in the beginning, middle, or end of words (K).

Rule IV. The terminative character for *tion*, *sion*, *cion*, *cian*, *tian*, is to be expressed by a small circle joined to the nearest letter, and turned to the right; and the plurals *tions*, *sions*, *cions*, *cians*, *tians*, *tience*, by a dot on the same side.

Rule V. The terminative character for *ing*, is to be expressed likewise by a small circle, but drawn to the left hand; and its plural *ings* by a dot (L).

Rule VI. The plural sign *s* is to be added to the terminative characters when necessary.

Rule VII. The separated terminations are never to be used but in polysyllables or words of more syllables than one.

These rules duly observed will point out a method as concise and elegant as can be desired, for expressing the most frequent and longest prepositions and terminations in the English language. If it should be thought necessary to increase their number by the addition of others, it will be an easy matter for any one of the least discernment to do so, by proceeding on the principles before laid down.

CHAP. V.

14 Rules for abbreviations. Though a more concise method of writing, or more numerous abbreviations, may not be indispensably necessary, if the foregoing directions be practised for a considerable time, yet contractions will be found extremely

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(I) The character for *h*, when lineality requires it, may be made from the bottom and inverted (see Plate CCCCLXXXII.) And often *h* may be omitted entirely, or a vowel may be substituted in its stead, without any injury to legibility, it being rather a breathing than letter.

(K) But in a few words where three horizontal characters meet, it will be better to express the *sis*, &c. by the semielliptical character in Plate CCCCLXXXII. opposite *tious*.

(L) In horizontal characters, by the left hand is meant the top, and by the right the space below the letter (see *ing* joined, Plate CCCCLXXXII.) In all other characters the right and left positions will naturally be known.

tremely uſeful and convenient to thoſe who have attained a proper knowledge of the ſubject, and lead to a greater degree of expedition, at the ſame time that they diminiſh the labour of writing. It has been obſerved in the introduction, that abbreviations are only to be employed by proficients in this art; becauſe expedition is not the firſt, though the ultimate, object in view: and that an eaſy legibility is of the utmoſt conſequence to the learner; which, however, cannot be preſerved, if he adopts too ſoon thoſe very rules which in time will afford him the greateſt eaſe when applied with judgement.

The following ſhort and practical rules will be found, we hope, fully adequate to every purpoſe for which they were intended, and are far ſuperior in the facility of their application to any which we have ſeen.

RULE I. The uſual abbreviations in long-hand are always to be followed; as Mr for Maſter, M. D. for Doctor of Phyſic, and Abp. for Archbiſhop, &c.

RULE II. Subſtantives, adjectives, verbs, and participles, when the ſenſe will direct to the meaning, are to be expreſſed by their initial conſonant with the diſtinguiſhing marks exhibited in Plate CCCCLXXXII. viz. a ſubſtantive muſt have the dot exactly over its initial conſonant; an adjective muſt have a dot under it; a verb is to be expreſſed by a comma over its initial conſonant; and a participle by a comma under (M). Theſe being the four principal parts of ſpeech will be ſufficient; and an adept will never be at a loſs to know when he can with ſafety apply this rule to them.

RULE III. To render the writing more legible, the laſt letter of the word may be joined to the firſt, and the proper mark applied.

RULE IV. The conſtituent or radical part of words, eſpecially if they are long, will often ſerve for the whole, or ſometimes the firſt ſyllable; as, we ought to moderate our *ex.* by our *circum.*; a man's *man.* commonly ſhape his *for.*

RULE V. All long words without exception may have their prepoſitions or terminations expreſſed by the incipient conſonant of ſuch prepoſition or termination.

RULE VI. When there is a great dependence between the parts of a ſentence, the initial letter will often ſuffice: as *L.* is the capital of Great *B.*; the eldeſt *S.* of the king of Great *B* is ſtyled prince of *W.* Every one, it is preſumed, will allow this to be perfectly legible in long-hand, then why may it not in ſtenography?

RULE VII. The terminations *neſs* and *leſs* may be omitted; as *faithfulneſs* is only to be written *faithful*; *forwardneſs*, *forward*; *heedleſs*, *heed*; *ſtubbornneſs*, *ſtubborn*, &c.

RULE VIII. The ſecond and third perſons of verbs, ending in *eth* and *eſt*, may be expreſſed by *s*; as, he *loves*, thou *teaches*; inſtead of he *loveth*, thou *teacheſt*: or even without *s*; as, he *love*, &c.

RULE IX. Words may often be entirely omitted, and yet no ambiguity enſue; as, *In beginning God created heaven and earth*, for In *the* beginning God created *the* heaven and *the* earth.

RULE X. When there is an immediate repetition of a ſentence or word, a line is to be drawn under the ſentence or word to be repeated: as, Amen, Amen, is to written *Amen*; but if any words intervene before a word or ſentence is to be repeated, the line muſt be drawn as before, and a A or mark of omiſſion placed where the repetition ſhould begin; as, *Is it juſt the innocents ſhould be* condemned A reviled?

The CONTENTS *of the* STENOGRAPHIC PLATES.

Fabricius's Reply to Pyrrhus.

As to my poverty, you have indeed, Sir, been rightly informed. My whole eſtate conſiſts in a houſe of but mean appearance, and a little ſpot of ground, from which by my own labour I draw my ſupport. But if by any means you have been perſuaded to think, that this poverty makes me leſs conſidered in my country, or in any degree unhappy, you are extremely deceived. I have no reaſon to complain of fortune, ſhe ſupplies me with all that nature requires; and if I am without ſuperfluities, I am alſo free from the deſire of them. With theſe I confeſs I ſhould be more able to ſuccour the neceſſitous, the only advantage for which the wealthy are to be envied; but as ſmall as my poſſeſſions are, I can ſtill contribute ſomething to the ſupport of the ſtate and the aſſiſtance of my friends. With regard to honours, my country places me, poor as I am, upon a level with the richeſt: for Rome knows no qualifications for great employments but virtue and ability. She appoints me to officiate in the moſt auguſt ceremonies of religion; ſhe entruſts me with the command of her armies; ſhe confides to my care the moſt important negotiations. My poverty does not leſſen the weight and influence of my counſels in the ſenate; the Roman people honour me for that very poverty which you conſider as a diſgrace; they know the many opportunities I have had in war to enrich myſelf without incurring cenſure; they are convinced of my diſintereſted zeal for their proſperity; and if I have any thing to complain of in the return they make, it is only the exceſs of their applauſe. What value then can I ſet upon your gold and ſilver! What king can add any thing to my fortune! Always attentive to diſcharge the duties incumbent on me, I have a mind free from ſelf-reproach, and I have an honeſt fame. *Dodſley's Preceptor.* Plate CCCCLXXXIII

Letter to a Friend againſt waſte of Time.

Converſe often with yourſelf, and neither laviſh your time, nor ſuffer others to rob you of it. Many of our hours are ſtolen from us, and others paſs inſenſibly away; but of both theſe loſſes the moſt ſhameful is that which happens through our own neglect. If we take the trouble to obſerve, we ſhall find that one conſiderable part of our life is ſpent in doing evil, and the other in doing

(M) The dot or comma being placed thus will never occaſion them to be miſtaken for vowels, becauſe they ſhould always be on one ſide or other; whereas the mark for parts of ſpeech muſt conſtantly be placed exactly over or under.

doing nothing, or in doing what we ſhould not do. We don't ſeem to know the value of time, nor how precious a day is; nor do we conſider that every moment brings us nearer our end. Reflect upon this, I entreat you, and keep a ſtrict account of time. Procraſtination is the moſt dangerous thing in life. Nothing is properly ours but the inſtant we breathe in, and all the reſt is nothing; it is the only good we poſſeſs; but then it is fleeting, and the firſt comer robs us of it. Men are ſo weak, that they think they oblige by giving of trifles, and yet reckon that time as nothing for which the moſt grateful perſon in the world can never make amends. Let us therefore conſider time as the moſt valuable of all things; and every moment ſpent, without ſome improvement in virtue or ſome advancement in goodneſs, as the greateſt ſublunary loſs.

St Paul's Speech before Agrippa and Feſtus.

I think myſelf happy, king Agrippa, that I ſhall anſwer for myſelf this day before thee, touching all things whereof I am accuſed of the Jews: eſpecially becauſe I know thee to be expert in all cuſtoms and queſtions which are among the Jews, wherefore I beſeech thee to hear me patiently. My manner of life from my youth, which was at firſt among mine own nation at Jeruſalem, know all the Jews, which knew me from the beginning (if they would teſtify), that, after the ſtraiteſt ſect of our religion I lived a Phariſee. And now I ſtand and am judged for the hope of the promiſe made by God unto our fathers: unto which promiſe our twelve tribes inſtantly ſerving God day and night hope to come; for which hope's ſake, king Agrippa, I am accuſed of the Jews. Why ſhould it be thought a thing incredible with you, that God ſhould raiſe the dead, when God himſelf has given aſſurance of it unto all men, in that he hath raiſed Chriſt from the dead? As for my own part, moſt noble Feſtus, I own I once verily thought that even I myſelf ought to do many things contrary to the name of Jeſus of Nazareth. Which thing I alſo did in Jeruſalem. I puniſhed the ſaints oft in every ſynagogue, and compelled them to blaſpheme; and being exceedingly mad againſt them, I perſecuted them even unto ſtrange cities. In purſuit of which, as I went to Damaſcus, with authority and commiſſion from the chief prieſts: At mid-day, O king, I ſaw in the way a light from heaven, above the brightneſs of the ſun, ſhining about me, and them which journeyed with me. And when we were all fallen to the earth, I heard a voice ſpeaking unto me, and ſaying in the Hebrew tongue, Saul, Saul, why perſecuteſt thou me? It is hard for thee to kick againſt the pricks. And I ſaid, Who art thou, Lord? And he ſaid, I am Jeſus whom thou perſecuteſt. But riſe, and ſtand upon thy feet: for I have appeared unto thee for this purpoſe, to make thee a miniſter and a witneſs both of theſe things which thou haſt ſeen, and of thoſe things in which I will appear unto thee. Whereupon, O king Agrippa, I was not diſobedient to the heavenly viſion: but ſhewed firſt unto them of Damaſcus, and at Jeruſalem, and throughout all the coaſts of Judea, and then to the Gentiles, that they ſhould repent and turn to God. For theſe cauſes the Jews caught me in the temple, and went about to kill me. Having therefore obtained help of God, I continue unto this day, witneſſing both to ſmall and great, ſaying none other things than thoſe which the prophets and Moſes did ſay ſhould come: That Chriſt ſhould ſuffer, and that he ſhould be the firſt that ſhould riſe from the dead, and ſhould ſhow light unto the people, and to the Gentiles. This is the real truth: Believe me, I am no peſtilent fellow, nor mover of ſedition; but always endeavour all that lies in me to preſerve a conſcience void of offence towards God and towards man: nor can the Jews prove the things whereof they now accuſe me. Neither am I, Feſtus, beſides myſelf; but ſpeak thus freely before the king, becauſe he knows theſe things to be fact; yea, I am fully perſuaded the king knows them all to be fact; for they were not done in a corner. King Agrippa, believeſt thou the prophets? I know that thou believeſt. And would to God that not only thou but alſo all that hear me this day, were altogether ſuch as I am except theſe bonds. *Holmes's Rhetoric.*

Pope to Atterbury.

Once more I write to you as I promiſed, and this once I fear will be the laſt; the curtain will ſoon be drawn between my friend and me, and nothing left but to wiſh you a long good night; may you enjoy a ſtate of repoſe in this life not unlike that ſleep of the ſoul which ſome have believed is to ſucceed it, where we lie utterly forgetful of that world from which we are gone, and ripening for that to which we are to go. If you retain any memory of the paſt, let it only image to you what has pleaſed you beſt; ſometimes preſent a dream of an abſent friend, or bring you back an agreeable converſation. But, upon the whole, I hope you will think leſs of the time paſt than the future; as the former has been leſs kind to you than the latter infallibly will be. Do not envy the world your ſtudies: They will tend to the benefit of men, againſt whom you can have no complaint; I mean, of all poſterity: and, perhaps, at your time of life, nothing elſe is worth your care. What is every year of a wiſe man's life but a cenſure or critic on the paſt? Thoſe whoſe date is the ſhorteſt, live long enough to laugh at one half of it: The boy deſpiſes the infant, the man the boy, the philoſopher both, and the Chriſtian all. You may now begin to think your manhood was too much a puerility; and you will never ſuffer your age to be but a ſecond infancy. The toys and baubles of your childhood are hardly now more below you than thoſe toys of our riper and our declining years; the drums and rattles of ambition, and the dirt and bubbles of avarice. At this time, when you are cut off from a little ſociety, and made a citizen of the world at large, you ſhould bend your talents not to ſerve a party, or a few, but all mankind. Your genius ſhould mount above that miſt, in which its participation and neighbourhood with earth hath long involved it: To ſhine abroad, and to heaven, ought to be the buſineſs and the glory of your preſent ſituation. Remember it was at ſuch a time that the greateſt lights of antiquity dazzled and blazed the moſt; in their retreat, in their exile, or in their death. But why do I talk of dazzling or blazing? it was then that they did good, that they gave light, and that they became guides to mankind. Thoſe aims alone are worthy of ſpirits truly great, and ſuch I therefore hope will be yours. Reſentment indeed may remain, perhaps cannot be quite extinguiſhed, in the nobleſt minds; but revenge will never harbour there: Higher principles than

than thoſe of the firſt, and better principles than thoſe of the latter, will infallibly influence men whoſe thoughts and whoſe hearts are enlarged, and cauſe them to prefer the whole to any part of mankind, eſpecially to ſo ſmall a part as one's ſingle ſelf. Believe me, my Lord, I look upon you as a ſpirit entered into another life, as one juſt upon the edge of immortality, where the paſſions and affections muſt be much more exalted, and where you ought to deſpiſe all little views and all mean retroſpects. Nothing is worth your looking back; and therefore look forward, and make (as you can) the world look after you; but take care it be not with pity, but with eſteem and admiration. I am, with the greateſt ſincerity and paſſion for your fame as well as happineſs, your, &c.

The above moſt charming and moſt affectionate letter was written about a month before Atterbury biſhop of Rocheſter was ſent into baniſhment, and is univerſally admired.

Stentorophonic || Stephens.

STENTOROPHONIC TUBE, a ſpeaking trumpet; thus called from Stentor, a perſon mentioned by Homer. See TRUMPET.

STEP, in a ſhip, a block of wood fixed on the decks or bottom of a ſhip, and having a hole in its upper ſide, fitted to receive the heel of a maſt or capſtern. The ſteps of the main and foremaſts of every ſhip reſt upon the kelſon, to which they are firmly ſecured by knees, bolts, or ſpike-nails. The ſtep of the mizen-maſt uſually reſts upon the lower deck.

STEPHANIUM, in botany: A genus of the *monogynia* order, belonging to the *pentandria* claſs of plants; and in the natural method ranking under the 47th order, *Stellatæ*. The calyx is monophyllous, turbinated, and quinquepartite; the corolla is monopetalous, funnel-ſhaped, having its tubes curved and ventricoſe: the pericarpium is a bilocular berry containing two ſeeds, flattened on one ſide and round on the other. This genus is nearly allied to that of *Pſychotria*. There is only one ſpecies, viz. *Guianenſe*, a native of the warmer parts of America.

STEPHANOPHORUS, in antiquity, the chief prieſt of Pallas, who preſided over the reſt. It was uſual for every god to have a chief prieſt; that of Pallas was the Stephanophorus juſt mentioned, and that of Hercules was called Dadouchus.—Stephanophorus was alſo a prieſt that aſſiſted the women in the celebration of the feſtival Theſmophoria.

STEPHANUS (Byzantinus), an able grammarian, who lived in the 5th or 6th century. He wrote a Dictionary, in which he made a great number of obſervations, borrowed from mythology and hiſtory, which ſhowed the origin of cities and colonies, of which we have nothing remaining but a mean abridgment by Hermolaus the grammarian; but from that work the learned have received great light; and Sigonius, Caſaubon, Scaliger, Salmaſius, &c. have employed themſelves in illuſtrating it.

STEPHEN, king of England. See ENGLAND, n° 108, &c.

STEPHEN, or *St Stephen's Day*, a feſtival of the Chriſtian church, obſerved on the 26th of December, in memory of the firſt martyr St Stephen.

STEPHENS, a family of printers deſervedly celebrated. They flouriſhed at the revival of learning, and contributed a great deal towards diſpelling the cloud of ignorance which had ſo long overſhadowed Europe. Some of the claſſics before the 16th century were in a great meaſure loſt, and all of them were exceedingly corrupted. By their abilities and indefatigable induſtry theſe defects were ſupplied, and the learned were furniſhed with beautiful and correct editions of the Greek and Roman authors. Thus the world was not only ſupplied with an inexhauſtible fund of amuſement and inſtruction in theſe ancient writings; but it is to the ardour which they inſpired, and to the model of elegance which they diſplayed, that the preſent advanced ſtate of literature is in a great meaſure owing. Stephens.

HENRY STEPHENS, the firſt of theſe illuſtrious men, was born in France, ſoon after the diſcovery of printing, perhaps about the year 1465. He ſettled as a printer at Paris, and was probably patronized by Louis XII. A great proportion of the books which he publiſhed were Latin: They are printed in the Roman letter, and are not inelegant, though ſome of them abound rather too much in contractions. He died about the year 1520, and left behind him three ſons, Francis, Robert, and Charles. His widow married Simon de Colines (*Colinæus* in Latin), who thus got poſſeſſion of Henry's printing-houſe, and continued the profeſſion till his death.

Of FRANCIS, the eldeſt ſon, little more is known than that he carried on buſineſs along with his father-in-law Colinæus, and that he died at Paris in 1550.

ROBERT STEPHENS, the ſecond ſon, was born in 1503. In his youth he made great proficiency in the Roman, Greek, and Hebrew languages, and at the age of 19 had acquired ſo much knowledge, that his father-in-law entruſted him with the management of his preſs. An edition of the New Teſtament was publiſhed under his inſpection, which gave great offence to the Paris divines, who accuſed him of hereſy, and threatened to prevent the ſale of the book. Soon after he began buſineſs himſelf, and married Perrete the daughter of Jodocus Badius, a printer and an author. She was a woman of learning, and underſtood Latin, which indeed was the neceſſary conſequence of her ſituation. Her huſband always entertained a number of learned men as correctors of the preſs: Being foreigners, and of different nations, they made uſe of no other language but Latin; which Perrete being accuſtomed to hear, was able in a ſhort time not only to underſtand, but even to ſpeak with tolerable eaſe.

In 1531 he publiſhed his Latin "Theſaurus;" a work of great importance, which he laboured at for two years. The mark which he put upon all his books was a tree branched, with a man looking upon it, and theſe words *noli altum ſapere*, to which he ſometimes added *ſed time*. In 1539, Francis I. made him his printer, and ordered a new ſet of elegant types to be founded for him. His frequent editions of the New Teſtament gave great offence to the doctors of the Sorbonne, who

Stephens. accuſed him of hereſy for his annotations, and inſiſted upon the ſuppreſſion of ſome of his books. Although Henry the French king in ſome meaſure protected him, the perſecution of theſe divines rendered him ſo unhappy, not to mention the expence and loſs of time which an almoſt conſtant attendance at court unavoidably occaſioned, that in 1552 he abandoned his country and went to Geneva. Here he embraced the Proteſtant religion, and thus juſtified in ſome meaſure the ſuſpicions of his theological enemies. It has been affirmed by ſeveral writers that he carried along with him the royal types, and the moulds alſo in which they were caſt; but it is certain that he never afterwards made uſe of thoſe types. Beſides, is it poſſible that the author of ſo daring a theft could have been not only protected in Geneva, but even courted and honoured by the moſt eminent men of the age? Is it credible that ſuch a crime could have been concealed for 60 years; or that Henry, the ſon and heir of the perpetrator, would have enjoyed the favour of the French king, if Robert Stephens had acted ſuch a ſhameful part? If he was burnt in effigy at Paris, it was not for theft, but for having changed his religion. After his arrival at Geneva, he publiſhed an account of the diſpute between him and the Paris divines, which does as much honour to his abilities as his *Theſaurus* does to his learning. He died in 1559, after a life of the moſt extraordinary induſtry. The books of which he was the editor were not fewer than 360. Many of them were ancient claſſics in different languages. Several were accompanied with annotations which he collected, and all of them were corrected by collating manuſcripts. He was ſo anxious to attain perfect accuracy, that he uſed to expoſe his proofs in public, and reward thoſe who diſcovered a miſtake. His books conſequently were very correct. It is ſaid that his New Teſtament, called *O Mirificam* (becauſe the preface begins with theſe words), has not a ſingle fault.

It was Robert Stephens who firſt divided the New Teſtament into verſes during a journey between Paris and Lyons. The advantages of this improvement are fully counterbalanced by its defects. It has deſtroyed the unity of the books, and induced many commentators to conſider every verſe as a diſtinct and independent aphoriſm. To this in ſome meaſure is to be aſcribed the many abſurd interpretations and creeds that have been forced out of that book.

By his laſt will his eſtate was left excluſively to ſuch of his children as ſhould ſettle at Geneva. He left behind him three ſons, Henry, Robert, and Francis.

Charles Stephens, the third ſon of Henry, was, like the reſt of his family, familiarly acquainted with the learned languages. This recommended him to Lazarus de Baif, who made him tutor to his ſon, and in 1540 carried him along with him to Germany. He ſtudied medicine, and practiſed it with ſucceſs in France. He did not, however, forſake the profeſſion of his family, but exerciſed it in Paris, where he became the editor of many books remarkable for neatneſs and elegance. He wrote above thirty treatiſes on different ſubjects, particularly on botany, anatomy, and hiſtory. He died in 1564.

Robert Stephens, the ſon of Robert the firſt of that name, did not accompany his father to Geneva, but continued to profeſs the Catholic religion, and to reſide at Paris. His letter was remarkably beautiful.— He was made king's printer, and died about 1589. Stephens.

His brother Francis was alſo a printer. He embraced the Proteſtant religion, and reſided at Geneva.

Henry Stephens, the remaining ſon of Robert, was born at Paris in 1528. He became the moſt learned and moſt celebrated of all his family. From his very birth almoſt he gave proofs of uncommon abilities, and diſplayed an ardent paſſion for knowledge. The Medea of Euripides, which he ſaw acted while at ſchool, firſt kindled his love for poetry, and inſpired him with the deſire of acquiring the language in which that tragedy is written. He intreated his father not to condemn him to ſtudy Latin, which he already underſtood from converſation, but to initiate him at once into the knowledge of Greek. His father willingly granted his requeſt; and Henry applied with ſuch vigour, that in a ſhort time he could repeat the Medea by heart. He afterwards ſtudied Greek under Peter Daneſius, who was tutor to the Dauphin, and finally heard the lectures of Tuſanus and Turnebus. He became eager at an early age to underſtand aſtrology, and accordingly attended a profeſſor of that myſterious art; but he was not long in diſcovering its abſurdity. At 19 he began his travels, which he undertook in order to examine foreign libraries, and to become acquainted with learned men. He ſpent two years in Italy, and returned into France completely maſter of Italian, and bringing along with him copies of ſeveral ſcarce authors, particularly a part of Anacreon, which before was thought loſt. Stephens.

He found his father publiſhing an edition of the New Teſtament, to which he prefixed ſome Greek verſes.— Soon after, he viſited England and the Netherlands, where he met with John Clement, an Engliſhman, to whom he was indebted for the remaining odes of Anacreon. During this journey he learned the Spaniſh language, which was very much ſpoken at that time in the Low Countries.

Whether Henry accompanied his father to Geneva or not is uncertain; at leaſt he muſt have returned immediately to France, for we find him ſoon after eſtabliſhed at Paris, and publiſhing the odes of Anacreon. In 1554 he went to Rome, and thence to Naples. This journey was undertaken at the requeſt, and in the ſervice, of the French government. He was diſcovered, and would have been arreſted as a ſpy, had he not by his addreſs and ſkill in the language of the country been able to paſs himſelf for a native of Italy. On his return to France he aſſumed the title of printer to Ulric Fugger, a very rich and learned German nobleman, who allowed him a conſiderable penſion.

In 1560 he married a relation, as is generally ſuppoſed, of Henry Scrimigeour, a Scotch nobleman, with whom he was intimately acquainted. She was a woman, as he himſelf informs us, endowed with the nobleſt ſpirit and the moſt amiable diſpoſitions. Her death, which happened in 1566, brought on a diſeaſe that had twice attacked him before. It was a diſguſt at all thoſe purſuits which had formerly charmed him, an averſion to reading and the ſight of books. It was probably occaſioned by too conſtant and ſevere an application to literary purſuits. In 1572 he publiſhed his *Theſaurus Linguæ Græcæ*, one of the greateſt works, perhaps, that ever was executed by one man, if we conſi-

The ALPHABET with the *Double* and *Triple* Consonants.

Let.	Char.	Arb. Abbrev.
a	˙	*a, an, above*
b	c	*be, by, because*
c	⌒	
d	ɔ	*do, did*
e	,	*ever, every, mid*
f	ɑ	*from, if*
g j	ơ	*God, give, gives*
h	ſ	*he, had, his*
i	.	*I, eye, below*
k	\	*king, know*
l	/	*Lord, will, all*
m	∩	*me, my, most*
n	∪	*and, in, nature*
o	.	*O, oh, owe, above*
p	ρ	*people, peace*
q	ɐ	*ques: tn quantity*
r	ſ	*or, are*
s	—	*is, us, soon*
t	ı	*the, to, it*
v	ơ	*have, save*
u	.	*you, view, middle*
w	⌐	*we, with*
x	ɗ	*except, example*
y	.	*ye, your, yes, bel*
=	—	⌒

D.C.	&c. Char.	Arb. Abbrev.
ch	⌝	*each, such*
sh	6	*shall, she*
th	ſ	*that, they*
thr	ρ	*therefore*
str	ɐ	*strive, strong*
wh	⌣	*who, which*

Vowels Places

	a.	*e.*	*i.*	*o.*	*u.*	*y.*
b	c	c	c	c	c	c
d	ɔ	ɔ	ɔ	ɔ	ɔ	ɔ
f	ɑ	ɑ	ɑ	ɑ	ɑ	ɑ
g	ơ	ơ	ơ	ơ	ơ	ơ
h	ſ	ſ	ſ	ſ	ſ	ſ
k	⌐	⌐	⌐	⌐	⌐	⌐
l	⌐	⌐	⌐	⌐	⌐	⌐
m	∩	∩	∩	∩	∩	∩
n	∪	∪	∪	∪	∪	∪
p	ρ	ρ	ρ	ρ	ρ	ρ
q	ɐ	ɐ	ɐ	ɐ	ɐ	ɐ
s	—	—	—	—	—	—
v	ơ	ơ	ơ	ơ	ơ	ơ
w	⌐	⌐	⌐	⌐	⌐	⌐
x	ɗ	ɗ	ɗ	ɗ	ɗ	ɗ

The *PREPOSITIONS and TERMINATIONS.*

Prepos.	Char.	Ex.	Signifi.
abs obs	c	c ∪	*abstain*
anti ante	,	ɔ	*antidote*
anta	,	ɔ	*antidote*
contr-i-a			
contro	\	\ ơ	*counterfeit*
counter			
dis-in-com	ɔ	ɔ ρ	*discompose*
hyp-o-er	ſ	ſ M	*hypocrite*
magn-i-a			
multi	∩	∩ ɑ	*magnify*
omni	.	. ⌣	*omniscience*
int-er-ro			
enter	∪	∪ ⌣	*entertain*
post			
preter	ρ	ρ ρ	*postpone*
recon			
recom	ı	ı ı	*reconcile*
satis			
super	—	— ɑ	*satisfy*
circum			
trans	ı	ı ɐ	*transfer*
ext-e-rin			
extra	ɗ	ɗ ρ	*extirpate*

Term.	Char.	Ex.	Signifi.
able ible	c	⌝ c	*stable*
flict			
flect			
full	ɑ	⌣ ɑ	*conflict*
ference			
ing	o	ơ	*thing*
ings	.	ſ	*things*
tion cion			
sian			
cian	o	ρ	*petition*
tian &c			
tions &c	.	ρ	*petitions*
sips cos			
sips sus			
tious	— n	⌊	*thesis*
cious &c			
less	ı	⌐ ı	*harmless*
ment	∩	⌐ ∩	*indictment*
self			
stract	—	⌐ —	*substract*
strict			
ward	—	⌐ —	*forward*

Arbitraries.

: *on one*	„ *as*
.. *for*	; *only*
o *of oft often*	o *nothing*
o *at am*	n *where-fore*

Points.

A Comma	,	*A Semicolon*	;
A Colon	:	*A Period*	/
A Point of Interrogation			?
A Point of Admiration			!

Figures.

1 2 3 4 5 6 7 8 9 0

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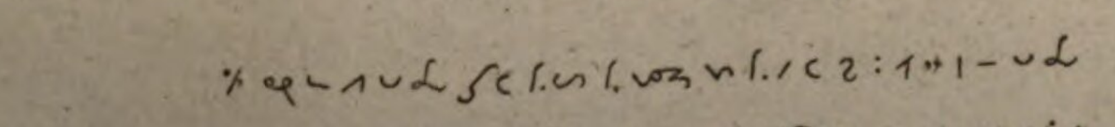
Abbreviating Marks

A Substantive	ı	*Division*	ɔ
An Adjective	ı	*Divisible*	?
A Verb	ı	*Divide*	ɔ
A Participle	ı	*Dividing*	?

The LORDS Prayer.



A. Bell Prin. Wal. Sculpter fecit.

FABRICIUS' Reply to PYRRHUS.

St PAULS SPEECH.

POPE *to* ATTERBURY.

LETTER &c.

Stephens. der the wretched materials which more ancient dictionaries could furniſh, if we conſider the ſize and perfection of the work, and the immenſe labour and learning which muſt have been employed in the compilation. This work had been carried on at a greater expence than he could well bear. He expected to be reimburſed by the ſale of the book, but he was unfortunately diſappointed. John Scapula, one of his own ſervants, extracted from it whatever he thought would be moſt ſerviceable to ſtudents, and publiſhed it beforehand in 4to. By this act of treachery Henry was reduced to poverty.

See Scapula.

About this time he was much beloved by Henry III. of France, who treated him ſo kindly, and made him ſuch flattering promiſes, that he reſided frequently at Court. But theſe promiſes were never fulfilled, owing to the civil wars which ſoon after diſtracted France, and the unfortunate death of king Henry himſelf. During the remainder of his life his ſituation was very unſettled. We find him ſometimes at Paris, ſometimes in Geneva, in Germany, and even in Hungary. He died at Lyons in 1598, at the age of 70. He was fond of poetry from his very infancy. It was a cuſtom of his to compoſe verſes on horſeback, and even to write them, though he generally rode a very mettleſome ſteed. His *Theſaurus* was his great work, but he was alſo the author of ſeveral other treatiſes. His poems are numerous: His Apology for Herodotus is a witty ſatire on the Roman Catholics. His Concordance to the New Teſtament muſt have been a laborious work, and has deſervedly endeared him to every Chriſtian who wiſhes to acquire a rational and critical knowledge of the Scriptures. The number of books which he publiſhed, though fewer than his father, was great, and ſuperior in elegance to any thing which the world had then ſeen. A great proportion of them were Greek; he was the editor, however, of many Roman and even of ſome eaſtern writings. His Greek claſſics are remarkably correct; the principal of them are Homer, Anacreon, Æſchylus, Maximus Tyrius, Diodorus Siculus, Pindar, Xenophon, Thucydides, Herodotus, Sophocles, Diogenes Laertius, Plutarch, Plato, Apollonius Rhodius, Æſchynes, Lyſias, Callimachus, Theocritus, Herodian, Dionyſius Hallicarnaſſenſis, Dion Caſſius, Iſocrates, Appian, Xiphilin, &c. His temper in the latter part of his life is repreſented as haughty and ſevere, owing probably to his diſappointments. He left behind him a ſon and two daughters, one of whom was married to the learned Iſaac Caſaubon,

PAUL STEPHENS, the ſon of Henry, continued his father's profeſſion at Geneva. He was a man of learning, and wrote tranſlations of ſeveral books, and publiſhed a conſiderable number of the ancient claſſics; but his editions poſſeſs little of his father's elegance. He died in 1627, at the age of 60, after ſelling his types to one Chouet a printer.—His ſon ANTONY, the laſt printer of the family, abandoned the Proteſtant religion, and returned to France, the country of his anceſtors. He received letters of naturalization in 1612, and was made printer to the king; but managing his affairs ill, he was reduced to poverty, and obliged to retire into an hoſpital, where he died in 1674, miſerable and blind, at the age of 80.

STEPHENS's Medicine for the Stone. See ALKALI, n° 17.

STERCORARIANS, or STERCORANISTÆ, formed from *ſtercus* "dung," a name which thoſe of the Romiſh church anciently gave to ſuch as held that the hoſt was liable to digeſtion, and all its conſequences, like other food.

Stercorarians || Sterling.

STERCULIA, in botany: A genus of plants belonging to the claſs of *monœcia*, and order of *monodelphia*; and in the natural ſyſtem under the 38th order, *tricoccæ*. The male calyx is quinquepartite; there is no corolla, but there are 15 filaments. The female calyx is quinquepartite; there is no corolla; the germen is placed on a pillar, and the capſule is quinquelocular, and many-ſeeded. There are three ſpecies, the balanghas, fœtida, and platanifolium, all foreign plants.

STEREOGRAPHIC PROJECTION, is the projection of the circles of the ſphere on the plane of ſome one great circle, the eye being placed in the pole of that circle. See *PROJECTION of the Sphere.*

STEREOMETRY, Στερεομετρια, formed of στερεος *ſolid*, and μετρον *meaſure*, that part of geometry which teaches how to meaſure ſolid bodies, *i. e.* to find the ſolidity or ſolid contents of bodies; as globes, cylinders, cubes, veſſels, ſhips, &c.

STEREOTOMY, formed from στερεος, and τομη, *ſection*, the art or act of cutting ſolids, or making ſections thereof; as walls and other membranes in the profiles of architecture.

STERILITY, barrenneſs, in oppoſition to fertility. It has been aſſerted by many authors, that all monſters produced by a mixture of different ſpecies of animals, ſuch as mules, are barren; but this does not hold univerſally, even with the mule, which is the inſtance moſt generally adduced. See MULE.

Sterility in women ſometimes happens from a miſcarriage, or violent labour injuring ſome of the genital parts; but one of the moſt frequent cauſes is the ſuppreſſion of the menſtrual flux.—There are other cauſes ariſing from various diſeaſes incident to thoſe parts; by which the uterus may be unfit to receive or retain the male ſeed;—from the tubæ fallopianæ being too ſhort, or having loſt their erective power; in either of which caſes no conception can take place;—from univerſal debility and relaxation; or a local debility of the genital ſyſtem; by which means, the parts having loſt their tone or contractile power, the ſemen is thrown off immediately *poſt coitum*;—from imperforation of the vagina, the uterus, or the *tubæ*, or from diſeaſed ovas, &c. Hence medical treatment can only avail in caſes ariſing from topical or univerſal debility; in correcting irregularities of the menſtrual flux, or in removing tumors, cicatrices, or conſtrictions of the paſſage, by the art of ſurgery.

STERIS, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *digynia*. The calyx is quinquepartite; the corolla wheel-ſhaped; the berry is unilocular, and many-ſeeded. There is only one ſpecies, the javana, a foreign plant.

STERLING, an epithet by which genuine Engliſh money is diſtinguiſhed. It is unneceſſary to mention the various conjectures of antiquaries about the origin and meaning of this appellation. The moſt probable opinion ſeems to be this, that ſome artiſts from Germany, who were called *Eſterlings*, from the ſituation of their country, had been employed in fabricating our money,

Henry's Hiſtory of Great Britain, vol. iii. p. 541.

Stern, Sterna.

money, which conſiſted chiefly of ſilver pennies; and that from them the penny was called an *eſterling*, and our money *eſterling* or *ſterling* money.

STERN, the poſterior face of a ſhip; or that part which is repreſented to the view of a ſpectator, placed on the continuation of the keel behind. The ſtern is terminated above by the taffarel, and below by the counters; it is limited on the ſides by the quarter-pieces, and the intermediate ſpace comprehends the galleries and windows of the different cabins. See *Quarter of a Ship*, Ship, and Ship-building.

Stern-Faſt, a rope uſed to confine the ſtern of a ſhip or boat to any wharf or jetty-head, &c.

Stern-Moſt, in ſea language, uſually denotes that part of a fleet of ſhips which is in the rear, or fartheſt a-ſtern, as oppoſed to head-moſt.

Stern-Poſt, a long ſtraight piece of timber erected on the extremity of the keel, to ſuſtain the rudder and terminate the ſhip behind.

This piece, which is expreſſed by B in the pieces of the hull, Plate CCCCLIV. fig. 1. ought to be well ſecured and ſupported; becauſe the ends of all the lower planks of the ſhip's bottom are fixed in a channel, cut on its ſurface; and the whole weight of the rudder is ſuſtained by it.

Stern-Sheets, that part of a boat which is contained between the ſtern and the aftmoſt or hindmoſt ſeat of the rowers. It is generally furniſhed with benches to accommodate the paſſengers. See Boat.

STERNA, the Tern; a genus of birds arranged under the order of *palmipedes*. The marks of this genus are a ſtraight, ſlender, pointed bill, linear noſtrils, a ſlender and ſharp tongue, very long wings, a ſmall back toe, and a forked tail. There are 25 ſpecies, according to Dr Latham; the caſpia, cayana, ſurinamenſis, fuliginoſa, africana, ſtolida, philippina, ſimplex, nilotica, boyſii, ſtriata, vittata, ſpadicea, piſcata, hirundo, panaya, cinerea, alba, minuta, ſinenſis, auſtralis, metopoleucos, fiſſipes, nigra, and obſcura. Three of theſe only are found in Great Britain; the hirundo, minuta, and fiſſipes.

1. The *hirundo*, common tern, or great ſea-ſwallow, weighs four ounces one-quarter; the length is 14 inches; the breadth 30; the bill and feet are of a fine crimſon; the former tipt with black, ſtraight, ſlender, and ſharp-pointed; the crown, and hind part of the head, black; the throat, and whole underſide of the body, white; the upper part, and the coverts of the wings, a fine pale grey. The tail conſiſts of 12 feathers; the exterior edges of the three outmoſt are grey, the reſt white; the exterior on each ſide is two inches longer than the others: in flying, the bird frequently cloſes them together, ſo as to make them appear one ſlender feather.

Latham's Synopſis, vol. vii.

This is a very common ſpecies; frequents our ſea-coaſts and banks of lakes and rivers during the ſummer, but moſt common in the neighbourhood of the ſea. It is found alſo in various parts of Europe and Aſia, according to the ſeaſon; in the ſummer as far as Greenland and Spitzbergen, migrating in turn to the ſouth of Auſtria and Greece. It lays three or four eggs about the month of June, of a dull olive colour, an inch and three quarters in length, marked with irregular black ſpots, intermixed with ſome others of a ſmaller ſize, and leſs bright; the little end is almoſt free from any markings. Theſe are laid among the graſs or moſs. The young are hatched in July, and quit the neſt very ſoon after. They are carefully fed by their parents, and fly in about ſix weeks. This bird appears to have all the actions on the water which the ſwallow has on land, ſkimming on the ſurface, and ſeizing on every inſect which comes in its way; beſides which, the moment it ſpies a fiſh in the water, it darts into that element, and ſeizing its prey ariſes as quickly to the place from which it dipped. Sterna, Sterne.

Theſe birds are alſo found in America; come into New England in May, and go away in autumn, and are called there the mackarel gull. At Hudſon's Bay they are known by the name of black-head. They are obſerved to lay their eggs in ſmall hollows on the ſhore, ſometimes lined with a few leaves. They are often found in great numbers on the iſlets in the middle of the rivers, and are thought good eating. The natives of Hudſon's Bay call them *Kenouch-ene ou keaſk*. They are bold, not fearing mankind, and in the time of incubation will attack any one, frequently darting down ſo as to touch a perſon's hat, without his giving the leaſt offence.

2. The *minuta*, or ſmaller ſea-ſwallow, (called by Linnæus *larus minuta*), weighs only two ounces five grains; the length 8 inches and a half; the breadth 19 and a half. The bill is yellow, tipt with black; the forehead and cheeks white; from the eyes to the bill is a black line; the top of the head and hind part black; the breaſt and under ſide of the body clothed with feathers ſo cloſely ſet together, and of ſuch an exquiſite rich gloſs and ſo fine a white, that no ſatin can be compared to it: the back and wings of a pale grey: the tail ſhort, leſs forked than that of the former, and white: the legs yellow: the irides duſky.—Theſe two ſpecies are very delicate, and ſeem unable to bear the inclemency of the weather on our ſhores during winter, for we obſerve that they quit their breeding places at the approach of it, and do not return till ſpring. The manners, haunts, and food of this ſpecies are the ſame with thoſe of the former; but they are far leſs numerous.

3. The *fiſſipes*, or black tern, is of a middle ſize between the firſt and ſecond ſpecies. The uſual length is 10 inches; the breadth 24; the weight two ounces and a half. The head, neck, breaſt, and belly, as far as the vent, are black; beyond is white; the male has a white ſpot under its chin; the back and wings are of a deep aſh colour: the tail is ſhort and forked; the exterior feather on each ſide is white; the others aſh-coloured: the legs and feet of a duſky red. Mr Ray calls this a *cloven-footed gull*, as the webs are depreſſed in the middle, and form a creſcent. Theſe birds frequent freſh waters, breed on their banks, and lay three ſmall eggs of a deep olive colour, much ſpotted with black. They are found during ſpring and ſummer in vaſt numbers in the Fens of Lincolnſhire, make an inceſſant noiſe, and feed on flies as well as water inſects and ſmall fiſh. Birds of this ſpecies are ſeen very remote from land. Kalm ſaw flocks of hundreds in the Atlantic Ocean, midway between England and America, and a later voyager ſaw one 240 leagues from the Lizard, in the ſame ocean.

STERNE (Laurence), an Engliſh writer of a very peculiar caſt, was born at Clomwell, in the ſouth of Ireland, on 24th November 1713. His father Roger Sterne was the grandſon of Sterne archbiſhop of York, who has been ſuppoſed, we know not upon what grounds, to

Sterne ‖ Sterno-hyoidæus.

to have been the author of the excellent book intitled "The Whole Duty of Man." Laurence inherited nothing of his anceſtor's manner of writing, but rather reſembled Rabelais, whoſe wit he carried with him even into the pulpit.

In 1722 he was ſent to ſchool at Halifax in Yorkſhire, where he continued till 1732, when he was removed to Jeſus College in Cambridge. How long he reſided in college, or what progreſs he made in literature or ſcience, is not known: his works diſplay rather native genius than profound erudition. Upon quitting the univerſity he went to York, and being in orders was preſented to the living of Sutton by the intereſt of his uncle Dr Sterne, a prebendary of that church. In 1741 he married, and was ſoon afterwards made a prebendary of York, by the intereſt alſo of his uncle, who was then upon very good terms with him; but "quickly quarrelled with him (he ſays), and became his bittereſt enemy, becauſe he would not be a party man, and write paragraphs in the newſpapers." By his wife's means he got the living of Stillington, but remained near 20 years at Sutton, doing duty at both places. He was then in very good health, which, however, ſoon after forſook him; and books, painting, fiddling, and ſhooting, were, as he tells us, his amuſements.

In 1760, he went to London to publiſh his two firſt volumes of "Triſtram Shandy;" and was that year preſented to the curacy of Coxwold. In 1762 he went to France, and two years after to Italy, for the recovery of his health; but his health never was recovered. He languiſhed under a conſumption of the lungs, without the ſlighteſt depreſſion of ſpirits, till 1768, when death put a period to his terreſtrial exiſtence.

The works of Sterne are very generally read. They conſiſt of, 1. The Life and Opinions of Triſtram Shandy; 2. Sermons; 3. A Sentimental Journey; 4. Letters, publiſhed ſince his death. In every ſerious page, and in many of much levity, the author writes in praiſe of benevolence, and declares that no one who knew him could ſuppoſe him one of thoſe wretches who heap misfortune upon misfortune: But we have heard anecdotes of him extremely well authenticated, which proved that it was eaſier for him to praiſe this virtue than to practiſe it. His wit is univerſally allowed; but many readers have perſuaded themſelves that they found wit in his blank pages, while it is probable that he intended nothing but to amuſe himſelf with the idea of the ſage conjectures to which theſe pages would give occaſion. Even his originality is not ſuch as is generally ſuppoſed by thoſe fond admirers of the Shandean manner, who have preſumed to compare him with Swift, Arbuthnot, and Butler. He has borrowed both matter and manner from various authors, as every reader may be convinced by the learned, elegant, and candid comments on his works publiſhed by Dr Farrier, in the fourth volume of the Memoirs of the Literary and Philoſophical Society of Mancheſter.

STERNOCOSTALES, commonly called the *muſculi triangulares ſterni*, in anatomy, are five pairs of fleſhy planes, diſpoſed more or leſs obliquely on each ſide the ſternum, on the inſides of the cartilages of the ſecond, third, fourth, fifth, and ſixth true ribs.

STERNO-HYOIDÆUS, in anatomy. See *Table of the Muſcles*, under the article ANATOMY.

STERNOMANTIS, in antiquity, a deſignation given to the Delphian prieſteſs, more uſually called PYTHIA.—Sternomantis is alſo uſed for any one that had a propheſying demon within him. Sternomantis ‖ Steward.

STERNOMASTOIDÆUS, a muſcle. See *Table of the Muſcles*, under ANATOMY.

STERNOTHYRCIDEUS, a muſcle. See *Table of the Muſcles*, under ANATOMY.

STERNUM. See ANATOMY, n° 37.

STERNUTATIVE, or STERNUTATORY, a medicine proper to produce ſneezing. See SNEEZING.

STETIN, or STETTIN, a ſeaport town of Germany, in the circle of Upper Saxony, and capital of Hither Pomerania, with the title of a duchy, and a caſtle. It had long a famous ſchool, which the wars of Germany never diſturbed. The ancient dukes of Pomerania reſided here; and it was taken by the elector of Brandenburg in 1676, but given to Sweden by the treaty of Nimeguen. In 1713 it ſubmitted to the allies; and then the ſaid elector was put in poſſeſſion again of this important place, which is a bulwark to the Marche of Brandenburg; and the fortifications have been greatly improved. It is now a flouriſhing place, and carries on a conſiderable trade. It is ſeated on the river Oder, 72 miles north of Francfort, and 70 north by eaſt of Berlin. E. Long. 14. 38. N. Lat. 53. 35. The duchy is 125 miles in length, and borders upon Mecklenburg, and partly upon Brandenburg. The breadth is from 17 to 25 miles, and it is divided by the river Oder into two parts.

STEW, a ſmall kind of fiſh-pond, the peculiar uſe of which is to maintain fiſh, and keep them in readineſs for the daily uſe of the family, &c.

STEWS (from the French *eſtuves*, i. e. *thermæ*, *balneum*), thoſe places which were permitted in England to women of profeſſed incontinency, and that for hire would proſtitute their bodies to all comers; ſo called, becauſe diſſolute perſons are wont to prepare themſelves for venereous acts by bathing; and hot baths were by Homer reckoned among the effeminate ſort of pleaſures. Theſe ſtews were ſuppreſſed by King Hen. VIII. about the year 1546.

STEWARD (*ſeneſcallus*, compounded of the Saxon *ſteda*, i. e. "room;" or *ſtead* and *weard*, "a ward" or "keeper"), an officer appointed in another's ſtead or place, and always taken for a principal officer within his juriſdiction. Of theſe there are various kinds. The greateſt officer under the crown is the lord high-ſteward of England, an office that was anciently the inheritance of the earls of Leiceſter, till forfeited by Simon de Mountfort to King Henry III. But the power of this officer is ſo very great, that it has not been judged ſafe to truſt it any longer in the hands of a ſubject, excepting only *pro hac vice*, occaſionally: as to officiate at a coronation, at the arraignment of a nobleman for high-treaſon, or the like. During his office, the ſteward bears a white ſtaff in his hand; and the trial, &c. ended, he breaks the ſtaff, and with it his commiſſion expires. There is likewiſe a lord-ſteward of the king's houſehold, who is the chief officer of the king's court, has the care of the king's houſe, and authority over all the officers and ſervants of the houſehold, except ſuch as belong to the chapel, chamber, and ſtable.

STEWARD, an officer in a ſhip of war, appointed by the purſer to diſtribute the different ſpecies of proviſions

Steward. sions to the officers and crew; for which purpose he is furnished with a mate and proper assistants.

Court of the Lord High STEWARD *of Great Britain*, is a court instituted for the trial of peers indicted for treason or felony, or for misprision of either. The office of this great magistrate is very ancient, and was formerly hereditary, or at least held for life, or *dum bene se gesserit*: but now it is usually, and hath been for many centuries past, granted *pro hac vice* only; and it hath been the constant practice (and therefore seems now to have become necessary) to grant it to a lord of parliament, else he is incapable to try such delinquent peer. When such an indictment is therefore found by a grand jury of freeholders in the King's-bench, or at the assizes before the justices of *oyer* and *terminer*, it is to be removed by a writ of *certiorari* into the court of the lord high-steward, which has the only power to determine it. A peer may plead a pardon before the court of King's-bench, and the judges have power to allow it, in order to prevent the trouble of appointing an high-steward merely for the purpose of receiving such plea: but he may not plead in that inferior court any other plea, as guilty or not guilty of the indictment, but only in this court; because, in consequence of such plea, it is possible that judgment of death might be awarded against him. The king, therefore, in case a peer be indicted of treason, felony, or misprision, creates a lord high-steward *pro hac vice* by commission under the great seal; which recites the indictment so found, and gives his Grace power to receive and try it *secundum legem et consuetudinem Angliæ*. Then when the indictment is regularly removed by writ of *certiorari*, commanding the inferior court to certify it up to him, the lord high-steward directs a precept to a sergeant at arms, to summon the lords to attend and try the indicted peer. This precept was formerly issued to summon only 18 or 20 selected from the body of the peers; then the number came to be indefinite; and the custom was for the lord-high-steward to summon as many as he thought proper (but of late years not less than 23); and that those lords only should sit upon the trial; which threw a monstrous weight of power into the hands of the crown, and this its great officer, of selecting only such peers as the then predominant party should most approve of. And accordingly, when the earl of Clarendon fell into disgrace with Charles II. there was a design formed to prorogue the parliament, in order to try him by a select number of peers; it being doubted whether the whole house could be induced to fall in with the views of the court. But now, by statute 7 W. III. c. 3. upon all trials of peers for treason or misprision, all the peers who have a right to sit and vote in parliament shall be summoned at least 20 days before such trial, to appear and vote therein; and every lord appearing shall vote in the trial of such peer, first taking the oaths of allegiance and supremacy, and subscribing the declaration against popery.

Blackstone's Commentaries, vol. iv.

During the session of parliament, the trial of an indicted peer is not properly in the court of the lord high-steward, but before the court last mentioned of our lord the king in parliament. It is true, a lord high-steward is always appointed in that case to regulate and add weight to the proceedings: but he is rather in the nature of a speaker *pro tempore*, or chairman of the court, than the judge of it; for the collective body of the peers are therein the judges both of law and fact, and the high-steward has a vote with the rest in right of his peerage. But in the court of the lord high-steward, which is held in the recess of parliament, he is the sole judge of matters of law, as the lords triors are in matters of fact; and as they may not interfere with him in regulating the proceedings of the court, so he has no right to intermix with them in giving any vote upon the trial. Therefore, upon the conviction and attainder of a peer for murder in full parliament, it hath been holden by the judges, that in case the day appointed in the judgment for execution should lapse before execution done, a new time of execution may be appointed by either the high court of parliament during its sitting, though no high-steward be existing, or, in the recess of parliament, by the court of King's bench, the record being removed into that court. Steward.

It has been a point of some controversy, whether the bishops have now a right to sit in the court of the lord-high-steward to try indictments of treason and misprision. Some incline to imagine them included under the general words of the statute of King William "all peers who have a right to sit and vote in parliament;" but the expression had been much clearer, if it had been "all lords," and not "all peers;" for though bishops, on account of the baronies annexed to their bishoprics, are clearly lords of parliament, yet their blood not being ennobled, they are not universally allowed to be peers with the temporal nobility: and perhaps this word might be inserted purposely with a view to exclude them. However, there is no instance of their sitting on trials for capital offences, even upon impeachments or indictments in full parliament, much less in the court we are now treating of; for indeed they usually withdraw voluntarily, but enter a protest, declaring their right to stay. It is observable, that in the 11th chapter of the constitutions of Clarendon, made in parliament 11th Hen. II. they are expressly excused, rather than excluded, from sitting and voting in trials, when they come to concern life or limb: *episcopi, sicut cæteri barones, debent interesse judiciis cum baronibus, quousque perveniatur ad diminutionem membrorum vel ad mortem.* And Becket's quarrel with the king hereupon was not on account of the exception (which was agreeable to the canon law), but of the general rule, that compelled the bishops to attend at all. And the determination of the house of lords in the earl of Danby's case, which hath ever since been adhered to, is consonant to these constitutions; "that the lords spiritual have a right to stay and sit in court in capital cases, till the court proceeds to the vote of guilty or not guilty." It must be noted, that this resolution extends only to trials in full parliament; for to the court of the lord high-steward (in which no vote can be given, but merely that of guilty or not guilty), no bishop, as such, ever was or could be summoned: and though the statute of King William regulates the proceedings in that court, as well as in the court of parliament, yet it never intended to new-model or alter its constitution; and consequently does not give the lords spiritual any right, in cases of blood, which they had not before. And what makes their exclusion more reasonable is, that they have no right to be tried themselves in the court of the lord high-steward, and therefore surely ought not to be judges there. For the privilege of being thus tried

Steward, Stewart.

depends upon nobility of blood rather than a ſeat in the houſe, as appears from the trials of popiſh lords, of lords under age, and (ſince the union) of the Scotch nobility, though not in the number of the ſixteen; and from the trials of females, ſuch as the queen conſort or dowager, and of all peereſſes by birth; and peereſſes by marriage alſo, unleſs they have, when dowagers, diſparaged themſelves by taking a commoner to their ſecond huſband.

Steward of the Chiltern Hundreds. See *Chiltern Hundreds.*

STEWART (Dr Matthew), was in 1717 born at Rothſay in the iſle of Bute, of which pariſh his father was the miniſter. Being intended for the church, he went through the uſual courſe of a grammar-ſchool education, and was in 1734 received as a ſtudent into the univerſity of Glaſgow. There he had the happineſs of having for his preceptors in moral ſcience and in mathematics the celebrated profeſſors Hutcheſon and Simſon; by the latter of whom he was inſtructed in what may not improperly be called the *arcana* of the ancient geometry.

Account of Dr Stewart in the Edinburgh Philoſophical Tranſactions, vol. i. by Mr Playfair.

Mr Stewart's views making it neceſſary for him to remove to Edinburgh, he was introduced by Dr Simſon to Mr Maclaurin, that his mathematical ſtudies might ſuffer no interruption; and he attended the lectures of that great maſter with ſuch advantage as might be expected from eminent abilities, directed by the judgment of him who made the philoſophy and geometry of Newton intelligible to ordinary capacities. Mr Stewart, however, had acquired, from his intimacy with Dr Simſon, ſuch a predilection for the ancient geometry, as the modern analyſis, however powerfully recommended, could not leſſen; and he kept up a regular correſpondence with his old maſter, giving him an account of his progreſs and his diſcoveries in geometry, and receiving in return many curious communications reſpecting the *Loci Plani* and the poriſms of Euclid. See Porism and Simson.

While the ſecond invention of poriſms, to which more genius was perhaps required than to the firſt diſcovery of them, employed Dr Simſon, Mr Stewart purſued the ſame ſubject in a different and new direction. In doing ſo, he was led to the diſcovery of thoſe curious and intereſting propoſitions which were publiſhed under the title of *General Theorems* in 1746. They were given without the demonſtrations; but did not fail to place their diſcoverer at once among the geometers of the firſt rank. They are for the moſt part poriſms, though Mr Stewart, careful not to anticipate the diſcoveries of his friend, gave them no other name than that of theorems.

Our author had before this period entered into the church; and obtained, through the patronage of the duke of Argyle and the earl of Bute, the living of Roſeneath, a retired country pariſh in the weſt of Scotland: but in 1747 he was elected to the mathematical chair in the univerſity of Edinburgh, which had become vacant the year before by the death of Mr Maclaurin. The duties of this office gave a turn ſomewhat different to his purſuits, and led him to think of the moſt ſimple and elegant means of explaining thoſe difficult propoſitions which were hitherto only acceſſible to men deeply verſed in the modern analyſis. In doing this, he was purſuing the object which of all others he moſt ardently wiſhed to attain, *viz.* the application of geometry to ſuch problems as the algebraic calculus alone had been thought able to reſolve. His ſolution of Kepler's problem was the firſt ſpecimen of this kind which he gave to the world; and it was impoſſible to have produced one more to the credit of the method he followed, or of the abilities with which he applied it. On this problem the utmoſt reſources of the integral calculus had been employed. But though many excellent ſolutions had been given, there was none of them at once direct in its method and ſimple in its principles. Mr Stewart was ſo happy as to attain both theſe objects; and his ſolution appeared in the ſecond volume of the Eſſays of the Philoſophical Society of Edinburgh for the year 1756. In the firſt volume of the ſame collection there are ſome other propoſitions of Mr Stewart's, which are an extenſion of a curious theorem in the fourth book of Pappus. They have a relation to the ſubject of poriſms, and one of them forms the 91ſt of Dr Simſon's Reſtoration. They are beſides very beautiful propoſitions, and are demonſtrated with all the elegance and ſimplicity of the ancient analyſis.

The proſecution of the plan which he had formed of introducing into the higher parts of mixed mathematics the ſtrict and ſimple form of ancient demonſtration, produced the *Tracts Phyſical and Mathematical*, which were publiſhed in 1761, and the *Eſſay on the Sun's Diſtance*, which was publiſhed in 1763. In this laſt work it is acknowledged that he employed geometry on a taſk which geometry cannot perform; but while it is granted that his determination of the ſun's diſtance is by no means free from error, it may ſafely be aſſerted that it contains a great deal which will always intereſt geometers, and will always be admired by them. Few errors in ſcience are redeemed by the diſplay of ſo much ingenuity, and what is more ſingular, of ſo much ſound reaſoning. The inveſtigation is everywhere elegant, and will probably be long regarded as a ſpecimen of the moſt arduous inquiry which has been attempted by mere geometry.

The *Sun's Diſtance* was the laſt work which Dr Stewart publiſhed; and though he lived to ſee ſeveral animadverſions on it made public, he declined entering into any controverſy. His diſpoſition was far from polemical; and he knew the value of that quiet which a literary man ſhould rarely ſuffer his antagoniſts to interrupt. He uſed to ſay, that the decition of the point in queſtion was now before the public; that if his inveſtigation was right it would never be overturned, and that if it was wrong it ought not to be defended. A few months before he publiſhed the eſſay juſt mentioned, he gave to the world another work, intitled *Propoſitiones Geometricæ More Veterum Demonſtratæ*. This title, it is ſaid, was given to it by Dr Simſon, who rejoiced in the publication of a work ſo well calculated to promote the ſtudy of the ancient geometry. It conſiſts of a ſeries of geometrical theorems for the moſt part new; inveſtigated firſt by an analyſis, and afterwards ſynthetically demonſtrated by the inverſion of the ſame analyſis.

Dr Stewart's conſtant uſe of the geometrical analyſis had put him in poſſeſſion of many valuable propoſitions which did not enter into the plan of any of the works that have been enumerated. Of theſe not a few have

Stewart || Stickleback.

have found a place in the writings of Dr Simſon, where they will for ever remain to mark the friendſhip of theſe two mathematicians, and to evince the eſteem which Dr Simſon entertained for the abilities of his pupil.

Soon after the publication of the *Sun's Diſtance*, Dr Stewart's health began to decline, and the duties of his office became burdenſome to him. In the year 1772 he retired to the country, where he afterwards ſpent the greater part of his life, and never reſumed his labours in the univerſity. But though mathematics had now ceaſed to be his buſineſs, they continued to be his amuſement till a very few years before his death, which happened on the 23d of January 1785, at the age of 68.

The habits of ſtudy, in a man of original genius, are objects of curioſity, and deſerve to be remembered. Concerning thoſe of Dr Stewart, his writings have made it unneceſſary to remark, that from his youth he had been accuſtomed to the moſt intenſe and continued application. In conſequence of this application, added to the natural vigour of his mind, he retained the memory of his diſcoveries in a manner that will hardly be believed. He rarely wrote down any of his inveſtigations till it became neceſſary to do ſo for the purpoſe of publication. When he diſcovered any propoſition, he would put down the enunciation with great accuracy, and on the ſame piece of paper would conſtruct very neatly the figure to which it referred. To theſe he truſted for recalling to his mind at any future period the demonſtration or the analyſis, however complicated it might be. Experience had taught him, that he might place this confidence in himſelf without any danger of diſappointment; and for this ſingular power he was probably more indebted to the activity of his invention than the mere tenaciouſneſs of his memory. Tho' he was extremely ſtudious, he read few books, and verified the obſervation of M. D'Alembert, that of all the men of letters, mathematicians read leaſt of the writings of one another. His own inveſtigations occupied him ſufficiently; and indeed the world would have had reaſon to regret the miſapplication of his talents, had he employed in the mere acquiſition of knowledge that time which he could dedicate to works of invention.

STEWART, in Scots law. See LAW, N° clviii. 5.

STEWARTIA, in botany: A genus of plants belonging to the claſs of *monodelphia*, and order of *polyandria*; and in the natural ſyſtem ranging under the 37th order, *Columniferæ*. The calyx is ſimple; the ſtyle is ſimple, with a quinquefid ſtigma; the apple is without juice, quinquelobed, monoſpermous, burſting open with a ſpring five ways. There is only one ſpecies, the *malacodendron*, which is a foreign plant.

STIBADIUM, among the Romans, a low kind of table couch or bed of a circular form, which ſucceeded to the triclinia, and was of different ſizes, according to the number of gueſts they were deſigned for. They were called *hexaclina*, *octaclina*, or *enneaclina*, according as they held ſix, eight, or nine gueſts, and ſo of any other number.

STIBIUM, a name for ANTIMONY.

STICHOS, a name given by the old writers to a pectoral confection, the principal ingredient of which was the herb *marrubium* or horehound.

STICKLEBACK, in ichthyology. See GASTEROSTEUS.

Foot-ſticks || Stil.

FOOT-STICKS, in printing, ſlips of wood that lie between the foot of the page and the chaſe, to which they are wedged faſt by the quoins, to keep the form firm, in conjunction with the ſide-ſticks, which are placed at the ſide of the page, and fixed in the ſame manner by means of quoins.

STIFFLE, or GREAT MUSCLE, in the manege, is the part of the hind leg of a horſe which advances towards his belly. This is a moſt dangerous part to receive a blow upon.

STIGMA, a brand or impreſſion with a hot iron; a mark of infamy. See STIGMATIZING.

STIGMA, in botany, the ſummit or top of the ſtyle, accounted by the ſexualiſts the female organ of generation in plants, which receives the fecundating duſt of the tops of the ſtamina, and tranſmits its vapour or effluvia through the ſtyle into the heart of the ſeed-bud, for the purpoſe of impregnating the ſeeds.

STIGMATA, in natural hiſtory, the apertures in different parts of the bodies of inſects communicating with the tracheæ or air-veſſels, and ſerving for the office of reſpiration.

STIGMATA, in antiquity, certain marks impreſſed on the left ſhoulders of the ſoldiers when liſted.

STIGMATA, were alſo a kind of notes or abbreviations, conſiſting only of points, diſpoſed various ways; as in triangles, ſquares, croſſes, &c.

STIGMATA, is alſo a term introduced by the Franciſcans, to expreſs the marks or prints of our Saviour's wounds, ſaid to have been miraculouſly impreſſed by him on the body of their ſeraphic father St Francis.

STIGMATIZING, among the ancients, was inflicted upon ſlaves as a puniſhment, but more frequently as a mark to know them by: in which caſe, it was done by applying a red-hot iron marked with certain letters to their fore-heads, till a fair impreſſion was made; and then pouring ink into their furrows, that the inſcription might be the more conſpicuous.

Soldiers were branded in the hand with the name or character of their general.

After the ſame manner, it was cuſtomary to ſtigmatize the worſhippers and votaries of ſome of the gods. The marks uſed on theſe occaſions were various; ſometimes they contained the name of the god, ſometimes his particular enſign, as the thunderbolt of Jupiter, the trident of Neptune, the ivy of Bacchus, &c. or they marked themſelves with ſome myſtical number, whereby the god's name was deſcribed. To theſe three ways of ſtigmatizing St John is ſuppoſed to refer (Rev. chap. xiii. ver. 16, 17.). Theodoret is of opinion, that the Jews were forbidden to brand themſelves with ſtigmata, becauſe the idolaters, by that ceremony, uſed to conſecrate themſelves to their falſe gods.

Among ſome nations, ſtigmatizing was conſidered as a diſtinguiſhing mark of honour and nobility. In Thrace, as Herodotus tells us *, it was practiſed by none but perſons of credit, nor omitted by any but perſons of the meaneſt rank. The ancient Britons are alſo ſaid to have imprinted on the bodies of their infants the figures of animals, and other marks, with hot irons.

* Lib. v.

STIL DE GRAIN, in the colour trade, the name of a compoſition uſed for painting in oil or water, and is made of a decoction of the lycium or Avignon berry, in alum-water, which is mixed with whiting into a paſte, and formed into twiſted ſticks. It ought to be

Stilago || Stillingfleet.

chosen of a fine gold yellow, very fine, tender, and friable, and free from dirt.

STILAGO, in botany; a genus of plants belonging to the class of *gynandria*, and order of *triandria*. There is one female. The calyx is monophyllous, and almost three-lobed. There is no corolla, and the berry is globular. There is only one species, the bunius.

STILBE, in botany; a genus of plants belonging to the class of *polygamia*, and order of *dioecia*. The exterior calyx of the hermaphrodite flower is triphyllous; the interior is quinquedentate and cartilaginous. The corolla is funnel-shaped and quinquefid. There are four stamina; and there is one seed in the interior calyx calyptrate. The female flower is similar, has no interior calyx nor fruit. There are three species, the pinastra, ericoides, and cornua, all foreign plants.

STILE. See STYLE.

STILL, the name of an apparatus used in chemistry and in the distillation of ardent spirits. See CHEMISTRY-*Index* at *Distillation* and *Still*.

STILL-Bottoms, in the distillery, a name given by the traders to what remains in the still after working the wash into low wines. These bottoms are procured in the greatest quantity from the malt-wash, and are of so much value to the distiller in the fattening of hogs, &c. that he often finds them one of the most valuable articles of the business.

STILLINGFLEET (Edward), bishop of Worcester, was the son of Samuel Stillingfleet gentleman, and was born at Cranborn in Dorsetshire in 1635. He was educated at St John's College, Cambridge; and having received holy orders, was, in 1657, presented to the rectory of Sutton in Nottinghamshire. By publishing his *Origines Sacræ*, one of the ablest defences of revealed religion that has ever been written, he soon acquired such reputation, that he was appointed preacher of the Rolls Chapel; and in January 1665 was presented to the rectory of St Andrew's, Holborn. He was afterwards chosen lecturer at the Temple, and appointed chaplain in ordinary to king Charles II. In 1668 he took the degree of doctor of divinity; and was soon after engaged in a dispute with those of the Romish religion, by publishing his discourse concerning the idolatry and fanaticism of the church of Rome, which he afterwards defended against several antagonists. In 1680 he preached at Guildhall chapel a sermon on Phil. iii. 26. which he published under the title of *The Mischief of Separation*; and this being immediately attacked by several writers, he in 1683 published his *Unreasonableness of Separation*. In 1685 appeared his *Origines Britannicæ*, or the Antiquities of the British Church, in folio. During the reign of king James II. he wrote several tracts against popery, and was prolocutor of the convocation, as he had likewise been under Charles II. After the Revolution he was advanced to the bishopric of Worcester, and was engaged in a dispute with the Socinians, and also with Mr Locke; in which last contest he is generally thought to have been unsuccessful. He died at Westminster in 1699, and was interred in the cathedral of Worcester, where a monument was erected to his memory by his son. Dr Stillingfleet wrote other works besides those here mentioned, which, with the above, have been reprinted in 6 vols. folio.

STILLINGFLEET (Benjamin), an ingenious naturalist, was grandson of the preceding. His father Edward was fellow of St John's College in Cambridge, F. R. S. M. D. and Gresham professor of physic: but marrying in 1692, he lost his lucrative offices and his father's favour; a misfortune that affected both himself and his posterity. However, going into orders, he obtained, by his father's means, the living of Newington-Butts, which he immediately exchanged for those of Wood-Norton and Swanton in Norfolk. He died in 1708. Stillingfleet.

Benjamin, his only son, was educated at Norwich school, which he left in 1720, with the character of an excellent scholar. He then went to Trinity-College in Cambridge, at the request of Dr Bentley, the master, who had been private tutor to his father, domestic chaplain to his grandfather, and much indebted to the family. Here he was a candidate for a fellowship, but was rejected by the master's influence. This was a severe and unexpected disappointment, and but little alleviated afterwards by the Doctor's apology, that it was a pity that a gentleman of Mr Stillingfleet's parts should be buried within the walls of a college.

Perhaps, however, this ingratitude of Dr Bentley was not of any real disservice to Mr Stillingfleet. By being thrown into the world, he formed many honourable and valuable connections. He dedicated some translations of Linnæus to the late lord Lyttleton, partly, he says, from motives of private respect and honour. Lord Barrington gave him, in a very polite manner, the place of the master of the barracks at Kensington; a favour to which Mr Stillingfleet, in the dedication of his Calendar of Flora to that nobleman, alludes with equal politeness, as well as with the warmest gratitude. His Calendar of Flora was formed at Stratton in Norfolk in the year 1755, at the hospitable seat of his very worthy and ingenious friend Mr Marsham, who had made several observations of that kind, and had communicated to the public his curious observations on the growth of trees. But it was to Mr Wyndham of Felbrig in Norfolk that he appears to have had the greatest obligations: he travelled abroad with him, spent much of his time at his house, and was appointed one of his executors (Mr Garrick was another), with a considerable addition to an annuity which that gentleman had settled upon him in his lifetime.

Mr Stillingfleet's genius seems, if we may judge from his works, to have led him principally to the study of natural history; which he prosecuted as an ingenious philosopher, an useful citizen, and a good man. In this walk of learning he mentions, as his friends, Dr Watson, Mr (afterwards Dr) Solander, Mr Hudson, Mr Price of Foxley, and some others; to whom may be added the ingenious Mr Pennant. Nor can we omit the flattering mention which the late Mr Gray makes of him in one of his letters, dated from London in 1761: "I have lately made an acquaintance with this philosopher, who lives in a garret here in the winter, that he may support some near relations who depend upon him. He is always employed, consequently (according to my old maxim) always happy, always cheerful, and seems to me a very worthy honest man. His present scheme is to send some persons, properly qualified, to reside a year or two in Attica, to make themselves acquainted with the climate, productions, and

Stillingfleet || Stilpo.

and natural hiſtory of the country, that we may underſtand Ariſtotle, Theophraſtus, &c. who have been heathen Greek to us for ſo many ages; and this he has got propoſed to lord Bute, no unlikely perſon to put it in execution, as he is himſelf a botaniſt."

Mr Stillingfleet publiſhed a volume of miſcellaneous tracts, which is in much eſteem, and does great honour to his head and heart. They are chiefly tranſlations of ſome eſſays in the *Amœnitates Academicæ*, publiſhed by Linnæus, interſperſed with ſome obſervations and additions of his own. In this volume he ſhows alſo a taſte for claſſical learning, and entertains us with ſome elegant poetical effuſions of his own. But his Eſſay on Converſation, publiſhed in the firſt volume of Dodſley's Collection of Poems, entitles him to a diſtinguiſhed rank among our Engliſh poets. This poem is addreſſed to Mr Wyndham, with all that warmth of friendſhip which diſtinguiſhes Mr Stillingfleet. As it is chiefly didactic, it does not admit of ſo many ornaments as ſome compoſitions of other kinds. However, it contains much good ſenſe, ſhows a conſiderable knowledge of mankind, and has ſeveral paſſages that in point of harmony and eaſy verſification would not diſgrace the writings of our moſt admired poets. Here more than once Mr Stillingfleet ſhows himſelf ſtill ſore for Dr Bentley's cruel treatment of him; and towards the beautiful and moral cloſe of it (where it is ſuppoſed he gives us a ſketch of himſelf) ſeems to hint at a mortification of a more delicate nature, which he is ſaid to have ſuffered from the other ſex.

To theſe diſappointments it was perhaps owing that Mr Stillingfleet neither married nor went into orders. His London reſidence was at a ſaddler's in Piccadilly; where he died in 1771, aged above 70, leaving ſeveral valuable papers behind him. He was buried in St James's church, without the ſlighteſt monument of his having exiſted.

STILLINGIA, in botany; a genus of plants belonging to the claſs of *monœcia*, and to the order of *monodelphia*. The male calyx is hemiſpherical and multiflorous. The corolla is tubulous, and eroſe or gnawed. The female calyx is uniflorous and inferior. The corolla is ſuperior. The ſtyle is trifid, and the capſule three-grained. There is only one ſpecies, the ſylvatica.

STILYARD. See *Steel-Yard*.

STILPO, a celebrated philoſopher of Megara, flouriſhed under the reign of Ptolemy Euergetes. In his youth he had been addicted to licentious pleaſures, from which he religiouſly refrained from the moment that he ranked himſelf among philoſophers. When Ptolemy Soter, at the taking of Megara, offered him a large ſum of money, and requeſted that he would accompany him into Egypt, he accepted but a ſmall part of the offer, and retired to the iſland of Ægina, whence, on Ptolemy's departure, he returned to Megara. That city being again taken by Demetrius the ſon of Antigonus, and the philoſopher required to give an account of any effects which he had loſt during the hurry of the plunder, he replied, that he had loſt nothing; for no one could take from him his learning and eloquence. So great was the fame of Stilpo, that the moſt eminent philoſophers of Athens took pleaſure in attending upon his diſcourſes. His peculiar doctrines were, that ſpecies or univerſals have no real exiſtence, and that one thing cannot be predicated of another. With reſpect to the former of theſe opinions, he ſeems to have taught the ſame doctrine with the ſect afterwards known by the appellation of *Nominaliſts*. To prove that one thing cannot be predicated of another, he ſaid, that *goodneſs* and *man*, for inſtance, are different things, which cannot be confounded by aſſerting the one to be the other: he argued farther, that goodneſs is an univerſal, and univerſals have no real exiſtence; conſequently, ſince nothing cannot be predicated of any thing, goodneſs cannot be predicated of man. Thus, whilſt this ſubtle logician was, through his whole argument, predicating one thing of another, he denied that any one thing could be the accident or predicate of another. If Stilpo was ſerious in this reaſoning; if he meant any thing more than to expoſe the ſophiſtry of the ſchools, he muſt be confeſſed to have been an eminent maſter of the art of wrangling; and it was not wholly without reaſon that Glycera, a celebrated courtezan, when ſhe was reproved by him as a corrupter of youth, replied, that the charge might be juſtly retorted upon himſelf, who ſpent his time in filling their heads with ſophiſtical quibbles and uſeleſs ſubtleties. In ethics he ſeems to have been a Stoic, and in religion he had a public and a private doctrine, the former for the multitude, and the latter for his friends. He admitted the exiſtence of a ſupreme divinity, but had no reverence for the Grecian ſuperſtitions.

Stilobatum || Stimuli.

Enfield's Hiſtory of Philoſophy, vol. i.

STILOBATUM, in architecture, denotes the body of the pedeſtal of any column.

STILTON, a town of England, in the county of Huntingdonſhire, 75 miles from London, ſouth-weſt of Yaxley, on the Roman highway from Caſtor to Huntingdon, called *Ermine-ſtreet*, ſome parts of which, in this neighbourhood, appear ſtill paved with ſtone. This place is famous for cheeſe which is called *Engliſh Parmeſan*, and is brought to table full of mites or maggots. For making Stilton cheeſe, we have the following receipt in the firſt volume of the *Repoſitory of Arts and Manufactures*:

"Take the night's cream, and put it to the morning's new milk, with the rennet; when the curd is come, it is not to be broken, as is done with other cheeſes, but take it out with a ſoil-diſh altogether, and place it in a ſieve to drain gradually; and as it drains, keep gradually preſſing it till it becomes firm and dry; then place it in a wooden hoop; afterwards to be kept dry on boards, turned frequently, with cloth binders round it, which are to be tightened as occaſion requires, and changed every day until the cheeſe become firm enough to ſupport itſelf; after the cloth is taken off, the cheeſe is rubbed every day all over, for two or three months, with a bruſh; and if the weather be damp or moiſt twice a-day; and even before the cloth is taken off, the top and bottom are well rubbed every day."

STIMULANTS, in medicine, ſubſtances which increaſe the action of certain parts of the body. In particular, they quicken the motion of the blood, increaſe the action of the muſcular fibres, and affect the nervous ſyſtem.

STIMULI, in botany; a ſpecies of armature or offenſive weapon, with which ſome plants, as nettle, caſſada, acalypha, and tragia, are furniſhed. Their uſe, ſays Linnæus, is by their venomous punctures to keep

Sting || Stiria.

keep off naked animals that would approach to hurt them.

STING, an apparatus in the bodies of certain inſects, in form of a little ſpear, ſerving them as a weapon of offence.

Sting-Ray, in ichthyology. See RAIA.

Falconer. Marine Dictionary.

STINK-POT, an earthen jar or ſhell, charged with powder, grenadoes, and other materials of an offenſive and ſuffocating ſmell. It is frequently uſed by privateers, in the weſtern ocean, in the attack of an enemy whom he deſigns to board; for which purpoſe it is furniſhed with a light fuſe at the opening or touch-hole. See BOARDING.

STINT, a ſpecies of the TRINGA.

STIPA, FEATHER GRASS, in botany: A genus of plants belonging to the claſs of *triandria*, and order of *digynia*; and in the natural ſyſtem ranging under the 4th order, *Gramina*. The calyx is bivalved. The exterior valve of the corolla is terminated by an awn; the baſe is jointed.

There are nine ſpecies, the pennata, juncea, capillata, ariſtella, tenaciſſima, avenacea, membranacea, arguens, and ſpicata. Of theſe one only is Britiſh, the *pennata* or common feather graſs. The beards are feathered. The plant riſes to the height of 10 inches, grows on mountains, and flowers in July or Auguſt.

STIPEND, among the Romans, ſignifies the ſame with tribute; and hence *ſtipendarii* were the ſame with *tributarii*.

STIPEND, in Scots law. See LAW, § clix. 12.

STIPULA, in botany, one of the fulcra or props of plants, defined by Linnæus to be a ſcale, or ſmall leaf, ſtationed on each ſide the baſe of the footſtalks of the flower and leaves, at their firſt appearance, for the purpoſe of ſupport. Elmgren reſtricts it to the footſtalks of the leaves only.

STIPULATION, in the civil law, the act of ſtipulating, that is, of treating and concluding terms and conditions to be inſerted in a contract. Stipulations were anciently performed at Rome, with abundance of ceremonies; the firſt whereof was, that one party ſhould interrogate, and the other anſwer, to give his conſent, and oblige himſelf. By the ancient Roman law, nobody could ſtipulate but for himſelf; but as the Tabelliones were public ſervants, they were allowed to ſtipulate for their maſters; and the notaries ſucceeding the Tabelliones have inherited the ſame privilege.

STIRIA, a province of Germany, in the circle of Auſtria, with the title of a duchy. It is bounded on the north by the archduchy of Auſtria, on the eaſt by Hungary, on the ſouth by Carniola, and on the weſt by Carinthia and the archbiſhopric of Saltſburg; being 125 miles in length and 17 in breadth. It is ſaid to contain 22 cities, 95 towns, 338 caſtles, 15 convents, and 200,000 inhabitants. Though it is a mountainous country, yet there is a great deal of land fit for tillage, and the ſoil is ſo good, that the inhabitants never were in want of corn. It contains mines of very good iron; whence the arms made there are in great eſteem. The women differ greatly from the Auſtrians, and are very plain and downright. They have all ſwellings on their throats, called *bronchoceles*. The men are alſo very ſimple, and are very zealous worſhippers of the Virgin Mary. They delight to ſit at home in the chimney-corner, never troubling their heads about foreign affairs. The chief town is Gratz.

Stirling.

STIRLING, a town of Scotland, ſituated on the river Forth, 35 miles north-weſt of Edinburgh, in W. Long. 3. 59. N. Lat. 56. 6. It is alſo called *Sterling* and *Striveling*; from the former of which Boethius falſely derives the name *Sterling money*; becauſe, ſays he, Oſbeit, a Saxon prince, after the overthrow of the Scots, eſtabliſhed a mint there. The name of *Striveling* is ſaid to have been derived from the frequency of ſtrifes or conflicts in the neighbourhood. The town contains about 4000 inhabitants. It has a manufacture of tartans and ſhalloons, and employs about 30 looms in that of carpets. The great ſtreet is very broad. In it is the tolbooth, where is kept the ſtandard for the wet meaſures of Scotland. The other ſtreets are narrow and irregular.—Stirling is in miniature a reſemblance of Edinburgh; being built on a rock of the ſame form, with a fortreſs on the ſummit. The origin of the caſtle is unknown. The rock of Stirling was ſtrongly fortified by the Picts, amongſt whom architecture and ſeveral other uſeful arts had made a conſiderable progreſs. As it lay in the extremities of their kingdom, the poſſeſſion of it was the occaſion of frequent conteſts betwixt them and their neighbours the Scots and Northumbrians; each of whoſe dominions did, for ſome time, terminate near it.

When the Scots, under Kenneth II. overthrew the Pictiſh empire near the middle of the ninth century, they endeavoured to obliterate every memorial of that people. They not only gave new names to provinces and towns, but, with all the rage of barbarians, demoliſhed many magnificent and uſeful edifices which had been reared up by them, and this fortreſs among the reſt. It was, however, ſoon rebuilt, though upon an occaſion not very honourable to the Scots.

Upon the death of Kenneth II. in 855, his brother Donald V. mounted the throne of Scotland. In the beginning of his reign the kingdom was invaded by Oſbrecht and Ella, two Northumbrian princes, who, uniting their forces with the Cumbrian Britons, and a number of Picts, who upon their expulſion from their native country had taken refuge in England, advanced to Jedburgh, where Donald encountered them; and, after a fierce and bloody battle, obtained a complete victory: but, having taken up his ſtation in Berwick, in ſupine ſecurity, the Northumbrians, informed of the careleſs poſture in which the Scottiſh army lay, ſurpriſed them by a haſty march, diſperſed them, and made a priſoner of the king. Purſuing the advantage they had gained, they marched northward, and ſubdued all before them to the Frith of Forth and the town of Stirling. But the forlorn ſituation of the Scots, without a king and without an army, obliging them to ſue for peace, they obtained it, upon condition that they ſhould pay a ſum of money for the ranſom of the king, and yield up all their dominions upon the ſouth ſide of the Forth to the conquerors.

The Northumbrians taking poſſeſſion of the territories ceded to them by this treaty, rebuilt the caſtle of Stirling, and planted it with a ſtrong garriſon, in order to preſerve their new conqueſts, upon the frontiers of which it was ſituated. Our authorities alſo inform

Stirling. us, that they erected a ſtone-bridge over the Forth, upon the ſummit of which a croſs was raiſed, with the following inſcription in monkiſh rhyme.

Anglos a Scotis ſeparat crux iſta remotis;
Armis hic ſtant Bruti, Scoti ſtant hic, cruce tuti.

Which is thus tranſlated by Bellenden.

I am free marche, as paſſengeris may ken,
To Scottis, to Britonis, and to Ingliſmen.

None of the ancient Engliſh hiſtorians mention this conqueſt. The whole ſtory, as well as the inſcription, wears much of a monkiſh garb; yet its authenticity is not a little confirmed by the arms of the town of Stirling, upon which is a bridge, with a croſs, and the laſt line of the above Latin diſtich is the motto round it.

We muſt not, however, imagine, that in thoſe times that fortreſs bore any reſemblance to the preſent ſtructure, which is adapted to the uſe of fire-arms. Its ſize and form probably reſembled thoſe caſtles which, under the feudal conſtitution, the Engliſh and Scottiſh barons uſed to erect upon their eſtates for dwelling-houſes; and which, in thoſe barbarous ages, they found neceſſary to fortify for their defence, not only againſt foreign invaders, but often againſt the attacks of their own neighbours. It is directly ſuch a Gothic figure as this which repreſents the *Caſtrum Strivelenſe* upon the arms of Stirling.

This fortreſs, after it had continued in the poſſeſſion of the Northumbrian Saxons about 20 years, was, together with the whole country upon the ſouth ſide of the Forth, reſtored to the Scots, upon condition of their aſſiſting the Saxons againſt their turbulent invaders the Danes. Upon the arms of Stirling are two branches of a tree, to repreſent the *Nemus Strivelenſe*; but the ſituation and boundaries of that foreſt, which was probably a wing of the Caledonian, cannot be aſcertained. Upon the ſouth of Stirling, veſtiges of a foreſt are ſtill diſcernible for ſeveral miles. Banks of natural timber ſtill remain in the caſtle-park, at Murray's wood, and near Nether Bannockburn; and ſtumps of trees, with much bruſhwood, are to be ſeen in all the adjacent fields.

When Kenneth III. received intelligence of the Danes having invaded his dominions, he appointed the caſtle of Stirling to be the place of rendezvous for his army; and he marched from thence to the battle of Loncarty, where he obtained a victory over thoſe rovers, in the end of the 10th century.

In the 12th century, this caſtle is ſpoken of as a place of great importance, and one of the ſtrongeſt fortreſſes in the kingdom. In 1174, a calamity, not unuſual amongſt the Scottiſh monarchs, befel William, who at that time occupied the throne. He was taken priſoner in an unſucceſsful expedition which he made into England; and, after having been detained 12 months in captivity, was releaſed, upon ſtipulating to pay a large ſum of money for his ranſom; and, until payment thereof, delivering into the hands of the Engliſh the four principal fortreſſes in the kingdom, which in thoſe days were Stirling, Edinburgh, Roxburgh, and Berwick. This was the firſt great aſcendant that England obtained over Scotland; and indeed the moſt important tranſaction which had paſſed between theſe kingdoms from the Norman conqueſt.

Though the Scottiſh monarchs, in their frequent perambulations through the kingdom, often viſited Stirling, and held their courts for ſome time in the caſtle; yet it did not become a royal reſidence till the family of Stuart mounted the throne, and it was from different princes of this family that it received its preſent form. It was the place of the nativity of James II.; and, when raiſed to the throne, he frequently kept his court in it. It is well known to have been the place where that prince perpetrated an atrocious deed, the murder of William earl of Douglas, whom he ſtabbed with his own hand. The royal apartments were at that time in the north-weſt corner of the caſtle, and are now the reſidence of the fort-major. The room where the murder was committed ſtill goes by the name of *Douglas's room*. See SCOTLAND, n° 304, 305. Stirling.

James III. contracting a fondneſs for the caſtle on account of its pleaſant ſituation, made it the chief place of his reſidence, and added ſeveral embelliſhments to it. He built within it a magnificent hall, which in thoſe days was deemed a noble ſtructure, and is ſtill entire. It now goes by the name of the *parliament-houſe*, having been deſigned for the accommodation of that ſupreme court. It was covered with an oaken roof of exquiſite workmanſhip, which, though very little decayed, was a few years ago removed to make way for one of more modern ſtructure. James alſo erected a college of ſecular prieſts in the caſtle, which he called the *chapel-royal*, and which proved one cauſe of his own ruin. As the expences neceſſary for maintaining the numerous officers of ſuch an inſtitution were conſiderable, he annexed to it the revenues of the rich priory of Coldingham in the Merſe, which at that time happened to become vacant. This priory had for a long time been holden by perſons connected with the family of Hume; and that family, conſidering it as belonging to them, ſtrongly oppoſed the annexation. The diſpute ſeems to have laſted ſeveral years; for one parliament had paſſed a vote, annexing the priory to the chapel-royal, and a ſubſequent one enacted a ſtatute prohibiting every attempt that was contrary or prejudicial to that annexation.

James V. was crowned in the caſtle of Stirling; and the palace, which is the chief ornament of it, was the work of that prince. This is a ſtately and commodious ſtructure, all of hewn ſtone, with much ſtatuary work upon it. It is built in form of a ſquare, with a ſmall court in the middle, in which the king's lions are ſaid to have been kept; and hence it ſtill goes by the name of the *lions den*. The palace contains many large and elegant apartments; the ground-ſtory is now converted into barrack-rooms for the ſoldiers of the garriſon; the upper affords a houſe for the governor, with lodgings for ſome of the ſubaltern officers.

Oppoſite to the palace, upon the north, ſtands an elegant chapel, which was built by James VI. for the baptiſm of his ſon prince Henry in 1594. In this chapel is preſerved the hulk of a large boat, which that whimſical monarch cauſed to be built and placed upon carriages, in order to convey into the caſtle the proviſions for that ſolemnity.

A ſtrong battery, with a tier of guns pointing to the bridge over the Forth, was erected during the regency of Mary of Lorraine, mother to queen Mary. It is called the *French battery*, probably becauſe conſtructed by engineers of that nation. The laſt addition was made

to

Stirling, Stirlingſhire.

to the fortifications in the reign of queen Anne. Formerly they reached no farther than the old gate, upon which the flag-ſtaff now ſtands: but in that reign they were conſiderably enlarged upon the ſide towards the town; and barracks, which are bomb proof, with ſeveral other conveniences for a ſiege, were erected.

Upon the ſouth ſide of the caſtle lies a park incloſed with a ſtone-wall, called the *king's park*, and near to the foot of the rock on which the caſtle ſtands, lay the royal gardens; veſtiges of the walks and parterres, with a few ſtumps of fruit-trees, are ſtill viſible; but by long neglect, and the natural wetneſs of the ſoil, the place is now little better than a marſh. In the gardens is a mount of earth in form of a table, with benches of earth around it, where, according to tradition, the court ſometimes held *fetes-champetres*. In the caſtle-hill is an hollow, comprehending about an acre of ground, and having all the appearance of an artificial work, which was uſed for jouſts, tournaments, and other feats of chivalry.

Northward of the caſtle lies the Govan, or perhaps more properly the *Gowling* hill (A); in the middle of which is a ſmall mount called *Hurly Haaky*, upon which duke Murdoch and his two ſons were executed for treaſonable practices in the reign of James I.

The proſpect from the caſtle is moſt delightful, as well as extenſive, being greatly beautified, eſpecially upon the eaſt, by the windings of the Forth; which are ſo many, that though the diſtance by land from Stirling to Alloa is, in a ſtraight line, not quite ſix miles, it is ſaid to be 24 by water. As this river generally runs upon plain ground, it rolls its ſtream in ſo ſlow and ſilent a manner, that what Silius Italicus ſaith of the Ticinus is applicable to it, if, inſtead of *lucenti* in that poet, we ſhould for once read *lutoſo*; for the clay-banks, together with the tide, which flows above Stirling, render the Forth perpetually muddy:

Vix credas labi, ripis tam mitis opacis
Somniferam ducit lutoſo gurgite lympham.

The lordſhip and caſtle of Stirling were a part of the uſual dowry of the queens of Scotland, at leaſt after the family of Stuart came to the throne, in which they were inveſted at their marriage.

Robert lord Erſkine was appointed governor of the caſtle by king David II. and the office continued in that family till 1715.

This fortreſs hath been the ſcene of many tranſactions. Being by its ſituation conſidered as a key to the northern parts of the kingdom, the poſſeſſion of it hath been always eſteemed of great importance to thoſe who fought to be maſters of Scotland. It was undoubtedly a place of ſtrength when the art of war by ordnance was in its infancy; but though it reſiſted the utmoſt efforts of the rebels in 1746, it could not now hold out three days if beſieged by an army of a few thouſand men conducted by an engineer of knowledge and integrity.

STIRLINGSHIRE, a county of Scotland, of which Stirling is the capital. It extends 20 miles in length and 12 in breadth; being bounded on the weſt by part of Lennox and Clydeſdale; on the eaſt, by Clackmannanſhire, the river Forth, and part of Lothian; on the ſouth-eaſt, by Lothian; and on the north, by Monteith. The face of the country is open and agreeable, diverſified by hill and dale, well watered with ſtreams and rivers; the principal of which is the Forth, riſing in the neighbourhood of a high mountain called *Ben-Lomond*, and, running eaſtward, forms the frith of Edinburgh. The ſouthern part is hilly, affording plenty of game, and paſturage for ſheep, horſes, and black cattle. The eaſtern part is fertile, producing plentiful harveſts of corn, and great abundance of coal. Lead-ore is found in different parts of the ſhire; and the rivers abound with pike, trout, and ſalmon.

Stirrup || Stock.

STIRRUP, in the manege, a reſt or ſupport for the horſeman's foot, for enabling him to mount and for keeping him firm in his ſeat.

Stirrups were unknown to the ancients. The want of them in getting upon horſeback was ſupplied by agility or art. Some horſes were taught to ſtoop to take their riders up; but the riders often leapt up by the help of their ſpears, or were aſſiſted by their ſlaves, or made uſe of ladders for the purpoſe. Gracchus filled the highways with ſtones, which were intended to anſwer the ſame end. The ſame was alſo required of the ſurveyors of the roads in Greece as part of their duty.

Menage obſerves, that St Jerome is the firſt author who mentions them. But the paſſage alluded to is not to be found in his epiſtles; and if it were there, it would prove nothing, becauſe St Jerome lived at a time when ſtirrups are ſuppoſed to have been invented, and after the uſe of ſaddles. Montfaucon denies the authenticity of this paſſage; and, in order to account for the ignorance of the ancients with regard to an inſtrument ſo uſeful and ſo eaſy of invention, he obſerves, that while cloths and houſings only were laid upon the horſes backs, on which the riders were to ſit, ſtirrups could not have been uſed, becauſe they could not have been faſtened with the ſame ſecurity as upon a ſaddle. But it is more probable, that in this inſtance, as in many others, the progreſs of human genius and invention is uncertain and ſlow, depending frequently upon accidental cauſes. *Berenger's Hiſtory and Art of Horſemanſhip*, vol. i. p. 65.

Stirrup of a Ship, a piece of timber put upon a ſhip's keel, when ſome of her keel happens to be beaten off, and they cannot come conveniently to put or fit in a new piece; then they patch in a piece of timber, and bind it on with an iron, which goes under the ſhip's keel, and comes up on each ſide of the ſhip, where it is nailed ſtrongly with ſpikes; and this they call a ſtirrup.

STOBÆUS (John), a laborious Greek writer, who lived at the end of the fourth century, compoſed many works, of which there are only his Collections remaining, and even theſe are not as he compoſed them; many things being inſerted by later authors. This work contains many important ſentiments collected from the ancient writers, poets, and philoſophers.

STOCK, in gardening, &c. the ſtem or trunk of a tree. What ſtock is moſt proper for each kind of fruit, ought as well to be conſidered and known, as what ſoil

(A) So called from the wailings and lamentations (in Scotch *gowlings*) that were made for Duke Murdoch.

Stock, Stockholm.

is moſt ſuitable to trees; for on theſe two things the future vigour of trees, and the goodneſs of fruit, equally depend. The beſt way for thoſe who intend to plant, is to raiſe their own ſtocks, by which they will be better aſſured of what they do; but if they ſhould buy their trees of nurſerymen, they ſhould diligently inquire upon what ſtocks they were propagated. See GRAFTING.

STOCK, in trade. See *CAPITAL Stock*.

STOCK-Broker. See BROKER and STOCKS.

STOCK-Dove, in zoology. See COLUMBA.

STOCK-Jobbing, the art or myſtery of trafficking in the public ſtocks or funds. See FUND and *Stock-JOBBING*.

STOCK Gilly-flower, in botany. See CHEIRANTHUS.

STOCKHOLM, the capital of Sweden, is ſituated in the province of Upland, in E. Long. 19. 30. and N. Lat. 59. 20. Its foundation is by the beſt Swediſh writers generally attributed to Birger Jarl, regent of the kingdom about the middle of the 13th century during the minority of his ſon Waldemar, who had been raiſed to the throne by the ſtates of the kingdom; but it was not before the laſt century that the royal reſidence was transferred from Upſala to this city.

This capital, which is very long and irregular, occupies, beſide two peninſulas, ſeven ſmall rocky iſlands, ſcattered in the Mæler, in the ſtreams which iſſue from that lake, and in a bay of the gulf of Bothnia. A variety of contraſted and enchanting views are formed by numberleſs rocks of granite riſing boldly from the ſurface of the water, partly bare and craggy, partly dotted with houſes, or feathered with wood. The harbour is an inlet of the Baltic: the water is clear as cryſtal, and of ſuch depth that ſhips of the largeſt burthen can approach the quay, which is of conſiderable breadth, and lined with ſpacious buildings and ware-houſes. At the extremity of the harbour ſeveral ſtreets riſe one above another in the form of an amphitheatre; and the palace, a magnificent building, crowns the ſummit. Towards the ſea, about two or three miles from the town, the harbour is contracted into a narrow ſtrait, and, winding among high rocks, diſappears from the ſight; and the proſpect is terminated by diſtant hills, overſpread with foreſt. It is far beyond the power of words, or of the pencil, to delineate theſe ſingular views. The central iſland, from which the city derives its name, and the Ritterholm, are the handſomeſt parts of the town. Excepting in the ſuburbs, where the houſes are of wood painted red, the generality of the buildings are of ſtone, or brick ſtuccoed white. The royal palace, which ſtands in the centre of Stockholm, and upon the higheſt ſpot of ground, was begun by Charles XI.: it is a large quadrangular ſtone edifice, and the ſtyle of architecture is both elegant and magnificent.

Coxe's Travels, vol. ii.

It is the habitation not only of the royal family, but alſo of the greater part of the officers belonging to the houſehold. It likewiſe comprehends the national or ſupreme court of juſtice, the colleges of war, chancery, treaſury, and commerce; a chapel, armoury, library, and office for the public records; but the greater number of inferior officers and ſervants belonging to the court, are, with the foot-guards, quartered on the burghers. The caſtle, and all the ſtately edifices in the kingdom, are covered with copper. The palace of the nobility, in which this order ſits during the ſeſſion of the diet, is an elegant building adorned on the outſide with marble ſtatues and columns, and on the inſide with painting and ſculpture. This and three other palaces ſtand on the banks of the lake, and are built on the ſame model, ſo as to compoſe an uniform piece of architecture. The bank, built at the expence of the city, is a noble edifice, and joins with many ſumptuous houſes belonging to the nobility in exhibiting a ſplendid appearance. The houſes of the burghers are generally built of brick in the city; but in the ſuburbs they are commonly made up of timber, and therefore very ſubject to conflagrations. Theſe houſes are often framed in Finland, according to the plan and dimenſions preſcribed: whence they are tranſported in pieces to Stockholm by water, and there ſet up by the carpenters. Theſe wooden habitations, if kept in proper repair, will laſt 30 or 40 years, and are deemed warmer, neater, and more healthy, than thoſe of brick or ſtone. To prevent the danger of conflagrations, the city is divided into 12 wards. In each of theſe there is a maſter and four aſſiſtants, who forthwith repair to the place where the fire breaks out; and all porters and labourers are obliged to range themſelves under the maſter of the ward to which they belong. A fire-watch patroles the ſtreets by night, to give warning or aſſiſtance as it may be wanted; and a centinel is maintained in the ſteeple of every church, to toll the bell on the firſt appearance of any ſuch accident. The police of Stockholm is entirely ſubjected to the regulations of the grand governor, aſſiſted by a deputy and bailiff of the caſtle. This city is the ſtaple of Sweden, to which all the commodities of the kingdom are brought for exportation, and where almoſt all the imports from abroad are depoſited. The port or haven formed by the lake Mæler is large enough to contain 1000 ſail of ſhipping; and furniſhed with a key or wharf about an Engliſh mile in length, to which the veſſels may lie with their broadſides. The greateſt inconveniences attending this ſituation are, the diſtance from the ſea, which is not within leſs than 10 miles of the town; the want of tides; and the winding of the river, which is remarkably crooked. It opens into the Baltic; and the entrance, which is dangerous and rocky, the Swedes have ſecured with two ſmall forts: within, it is perfectly ſafe and commodious. The northern ſuburbs are remarkable for the king's gardens, and for the great number of artiſans who have choſen their habitations in this quarter. In the ſouthern ſuburbs the Muſcovite commodities are ſold; and here is a magnificent exchange where the merchants daily aſſemble.

Stockholm, Stocking.

STOCKING, that part of the clothing of the leg and foot which immediately covers and ſcreens them from the rigour of the cold. Anciently, the only ſtockings in uſe were made of cloth, or of milled ſtuffs ſewed together; but ſince the invention of knitting and weaving ſtockings of ſilk, wool, cotton, thread, &c. the uſe of cloth ſtockings is quite diſcontinued. Dr Howel, in his Hiſtory of the World (vol. ii. p. 222.) relates, that queen Elizabeth, in 1501, was preſented with a pair of black knit ſilk ſtockings by her ſilk-woman, and thenceforth ſhe never wore cloth ones any more. The ſame author adds, that king Henry VIII. ordinarily wore cloth hoſe, except there came from Spain, by great chance, a pair of ſilk ſtockings. His ſon, king Edward VI. was preſented with a pair of long Spaniſh ſilk ſtockings by Sir Thomas Greſham,

Stocking, Stocks.

and the preſent was then much taken notice of. Hence it ſhould ſeem, that the invention of knit ſilk ſtockings originally came from Spain. Others relate, that one William Rider, an apprentice on London bridge, ſeeing at the houſe of an Italian merchant a pair of knit worſted ſtockings from Mantua, took the hint, and made a pair exactly like them, which he preſented to William earl of Pembroke, and that they were the firſt of that kind worn in England, anno 1564.

The modern ſtockings, whether woven or knit, are formed of an infinite number of little knots, called *ſtitches*, *loops*, or *meſhes*, intermingled in one another.

Knit ſtockings are wrought with needles made of poliſhed iron, or braſs wire, which interweave the threads and form the meſhes the ſtocking conſiſts of. At what time the art of knitting was invented it is perhaps impoſſible to determine, though it has been uſually attributed to the Scots, as it is ſaid that the firſt works of this kind came from Scotland. It is added, that it was on this account that the company of ſtocking-knitters, eſtabliſhed at Paris 1527, took for their patron St Fiacre, who is ſaid to have been the ſon of a king of Scotland. But it is moſt probable that the method of knitting ſtockings by wires or needles was firſt brought from Spain.

Woven ſtockings are generally very fine; they are manufactured on a frame or machine made of poliſhed iron, the ſtructure of which it is needleſs to deſcribe, as it may be ſeen in almoſt every conſiderable town in Great Britain. The invention of this machine is, by Mr Anderſon, attributed to William Lee, M. A. of St John's College, Cambridge, at a period ſo early as 1589. Others have given the credit of this invention to a ſtudent of Oxford at a much later period, who, it is ſaid by Aaron Hill*, was driven to it by dire neceſſity. This young man, falling in love with an inn-keeper's daughter, married her though ſhe had not a penny, and he by his marriage loſt a fellowſhip. They ſoon fell into extreme poverty; and their marriage producing the conſequences naturally to be expected from it, the amorous pair became miſerable, not ſo much on account of their ſufferings, as from the melancholy dread of what would become of their yet unborn infant. Their only means of ſupport were the knitting of ſtockings, at which the woman was very expert: "But ſitting conſtantly together from morning to night, and the ſcholar often fixing his eyes, with ſtedfaſt obſervation, on the motion of his wife's finger's in the dexterous management of her needles, he took it into his imagination, that it was not impoſſible to contrive a little loom which might do the work with much more expedition. This thought he communicated to his wife, and joining his head to her hands, the endeavour ſucceeded to their wiſh. Thus the ingenious ſtocking-loom, which is ſo common now, was firſt invented; by which he did not only make himſelf and his family happy, but has left his nation indebted to him for a benefit which enables us to export ſilk ſtockings in great quantities, and to a vaſt advantage, to thoſe very countries from whence before we uſed to bring them at conſiderable loſs in the balance of our traffic."

* See *An Account of the Riſe and Progreſs of the Beech Oil Invention*, &c. 8vo. 1715.

STOCKS, *or* PUBLIC FUNDS *in England.* By the word *ſtock* was originally meant a particular ſum of money contributed to the eſtabliſhing of a fund to enable a company to carry on a certain trade, by means of which the perſon became a partner in that trade, and received a ſhare of the profit made thereby, in proportion to the money employed. But this term has been extended farther, though improperly, to ſignify any ſum of money which has been lent to the government, on condition of receiving a certain intereſt till the money is repaid, and which makes a part of the national debt. As the ſecurity both of the government and of the public companies is eſteemed preferable to that of any private perſon, as the ſtocks are negotiable and may be ſold at any time, and as the intereſt is always punctually paid when due; ſo they are thereby enabled to borrow money on a lower intereſt than what could be obtained from lending it to private perſons, where there muſt be always ſome danger of loſing both principal and intereſt.

Stocks, Stockton.

But as every capital ſtock or fund of a company is raiſed for a particular purpoſe, and limited by parliament to a certain ſum, it neceſſarily follows, that when that fund is completed, no ſtock can be bought of the company; though ſhares already purchaſed may be transferred from one perſon to another. This being the caſe, there is frequently a great diſproportion between the original value of the ſhares and what is given for them when transferred: for if there are more buyers than ſellers, a perſon who is indifferent about ſelling will not part with his ſhare without a conſiderable profit to himſelf; and on the contrary, if many are diſpoſed to ſell, and few inclined to buy, the value of ſuch ſhares will naturally fall in proportion to the impatience of thoſe who want to turn their ſtock into ſpecie.

A ſtock may likewiſe be affected by the court of chancery; for if that court ſhould order the money, which is under their direction, to be laid out in any particular ſtock, that ſtock, by having more purchaſers, will be raiſed to a higher price than any other of the like value.

By what has been ſaid, the reader will perceive how much the credit and intereſt of the nation depends on the ſupport of the public funds. While the annuities and intereſt for money advanced is there regularly paid, and the principal inſured by both prince and people (a ſecurity not to be had in other nations), foreigners will lend us their property, and all Europe be intereſted in our welfare; the paper of the companies will be converted into money and merchandiſe, and Great Britain can never want caſh to carry her ſchemes into execution. See the article FUND.

STOCKS, a frame erected on the ſhore of a river or harbour, whereon to build ſhipping. It generally conſiſts of a number of wooden blocks, ranged parallel to each other, at convenient diſtances, and with a gradual declivity towards the water.

STOCKS, a wooden machine to put the legs of offenders in, for ſecuring diſorderly perſons, and by way of puniſhment in divers caſes, ordained by ſtatute, &c.

STOCKTON upon Tees, a handſome town in the county of Durham, about 16 miles ſouth of the city of Durham. It is now a port of conſiderable trade; though, at the Reſtoration, it was a deſpicable village, the beſt houſe in which could hardly boaſt of any thing better than clay-walls and a thatched roof.

About

Stoebe || Stone.

About 40 years ago it ſent out in one year 75 veſſels for the port of London; and the trade is much increaſed ſince.

STOEBE, BASTARD ÆTHIOPIAN, in botany: A genus of plants belonging to the claſs of *ſyngeneſia*, and order of *polygamia ſegregata*; and in the natural ſyſtem ranging under the 49th order, *compoſitæ*. The calycle is uniflorous; the corollets are tubular and hermaphrodite; the receptacle is naked, and the pappus is feathery. There are nine ſpecies, the æthiopica, ericoides, proſtrata, gnaphaloides, gomphrenoides, ſcabra, reflexa, rhinocerotis, and diſticha; all plants of foreign growth.

STOICS, the name given to a ſect of Grecian philoſophers, from στοα, "the porch in Athens," which the founder of the ſect choſe for his ſchool. For the peculiar tenets of this ſect, ſee METAPHYSICS, Chap. IV. Part 3. MORAL PHILOSOPHY, n° 8. and ZENO.

STOLBERG, a ſmall town of Germany, in the circle of Upper Saxony, and territory of Thuringia, of which it is the capital place. It is ſeated between two mountains, 58 miles north-weſt of Leipſic. E. Long. 11. 8. N. Lat. 51. 42.

STOLE, a ſacerdotal ornament worn by the Romiſh pariſh-prieſts above their ſurplice, as a mark of ſuperiority in their reſpective churches; and by other prieſts over the alb, at celebrating of maſs, in which caſe it goes acroſs the ſtomach; and by deacons, over the left-ſhoulder, ſcarf-wiſe: when the prieſt reads the goſpel for any one, he lays the bottom of his ſtole on his head. The ſtole is a broad ſwath, or ſlip of ſtuff, hanging from the neck to the feet, with three croſſes thereon.

Groom of the STOLE, the eldeſt gentleman of his Majeſty's bed-chamber, whoſe office it is to preſent and put on his majeſty's firſt garment, or ſhirt, every morning, and to order the things in the chamber.

STOMACH, in anatomy. See ANATOMY, n° 91.

STOMACHIC, medicines that ſtrengthen the ſtomach and promote digeſtion, &c.

Stomachic corroboratives are ſuch as ſtrengthen the tone of the ſtomach and inteſtines; among which are carminatives, as the roots of galangals, red gentian, zedoary, pimpinella, calamus aromaticus, and arum. Of barks and rinds, thoſe of canella alba, ſaſſafras, citrons, Seville and China oranges, &c. Of ſpices, pepper, ginger, cloves, cinnamon, cardamums, and mace.

STONE (Edmund), a diſtinguiſhed ſelf-taught mathematician, was born in Scotland; but neither the place nor time of his birth are well known; nor have we any memoirs of his life, except a letter from the Chevalier de Ramſay, author of the Travels of Cyrus, in a letter to father Caſtel, a Jeſuit at Paris, and publiſhed in the Memoirs de Trevoux, p. 109, as follows: "True genius overcomes all the diſadvantages of birth, fortune, and education; of which Mr Stone is a rare example. Born a ſon of a gardener of the duke of Argyle, he arrived at eight years of age before he learnt to read.—By chance a ſervant having taught young Stone the letters of the alphabet, there needed nothing more to diſcover and expand his genius. He applied himſelf to ſtudy, and he arrived at the knowledge of the moſt ſublime geometry and analyſis, without a maſter, without a conductor, without any other guide but pure genius. Stone.

"At 18 years of age he had made theſe conſiderable advances without being known, and without knowing himſelf the prodigies of his acquiſitions. The duke of Argyle, who joined to his military talents a general knowledge of every ſcience that adorns the mind of a man of his rank, walking one day in his garden, ſaw lying on the graſs a Latin copy of Sir Iſaac Newton's celebrated *Principia*. He called ſome one to him to take and carry it back to his library. Our young gardener told him that the book belonged to him. 'To you?' replied the Duke. 'Do you underſtand geometry, Latin, Newton?' I know a little of them, replied the young man with an air of ſimplicity ariſing from a profound ignorance of his own knowledge and talents. The Duke was ſurpriſed; and having a taſte for the ſciences, he entered into converſation with the young mathematician: he aſked him ſeveral queſtions, and was aſtoniſhed at the force, the accuracy, and the candour of his anſwers. 'But how, ſaid the Duke, came you by the knowledge of all theſe things?' Stone replied, 'A ſervant taught me, ten years ſince, to read: does one need to know any thing more than the 24 letters in order to learn every thing elſe that one wiſhes?' The Duke's curioſity redoubled—he ſat down upon a bank, and requeſted a detail of all his proceedings in becoming ſo learned.

"I firſt learned to read, ſaid Stone: the maſons were then at work upon your houſe: I went near them one day, and I ſaw that the architect uſed a rule, compaſſes, and that he made calculations. I inquired what might be the meaning and uſe of theſe things; and I was informed that there was a ſcience called Arithmetic: I purchaſed a book of arithmetic, and I learned it.—I was told there was another ſcience called Geometry: I bought the books, and I learnt geometry. By reading I found that there were good books in theſe two ſciences in Latin: I bought a dictionary, and I learned Latin. I underſtood alſo that there were good books of the ſame kind in French: I bought a dictionary, and I learned French. And this, my lord, is what I have done: it ſeems to me that we may learn every thing when we know the 24 letters of the alphabet."

This account charmed the Duke. He drew this wonderful genius out of his obſcurity; and he provided him with an employment which left him plenty of time to apply himſelf to the ſciences. He diſcovered in him alſo the ſame genius for muſic, for painting, for architecture, for all the ſciences which depend on calculations and proportions."

"I have ſeen Mr Stone. He is a man of great ſimplicity. He is at preſent ſenſible of his own knowledge; but he is not puffed up with it. He is poſſeſſed with a pure and diſintereſted love for the mathematics, though he is not ſolicitous to paſs for a mathematician; vanity having no part in the great labour he ſuſtains to excel in that ſcience. He deſpiſes fortune alſo; and he has ſolicited me twenty times to requeſt the duke to give him leſs employment, which may not be worth the half of that he now has, in order to be more retired, and leſs taken off from his favourite ſtudies. He diſcovers ſometimes, by methods of his

Stone

own, truths which others have discovered before him. He is charmed to find on these occasions that he is not a first inventor, and that others have made a greater progress than he thought. Far from being a plagiary, he attributes ingenious solutions, which he gives to certain problems, to the hints he has found in others, although the connection is but very distant," &c.

Mr Stone was author and translator of several useful works; viz. 1. A New Mathematical Dictionary, in 1 vol. 8vo, first printed in 1726. 2. Fluxions, in 1 vol. 8vo, 1730. The Direct Method is a translation from the French, of Hospital's Analyse des Infiniments Petits; and the Inverse Method was supplied by Stone himself. 3. The Elements of Euclid, in 2 vols. 8vo, 1731. A neat and useful edition of those Elements, with an account of the life and writings of Euclid, and a defence of his elements against modern objectors. Beside other smaller works. Stone was a fellow of the Royal Society, and had inserted in the Philosophical Transactions (vol. 41, p. 218) an "Account of two species of lines of the 3d order, not mentioned by Sir Isaac Newton or Mr Stirling."

Stone (Jerome), the son of a reputable seaman, was born in the parish of Scoonie, in the county of Fife, North Britain. His father died abroad when he was but three years of age, and his mother, with her young family, was left in very narrow circumstances. Jerome, like the rest of the children, having got the ordinary school education, reading English, writing, and arithmetic, betook himself to the business of a travelling chapman. But the dealing in buckles, garters, and such small articles, not suiting his superior genius, he soon converted his little stock into books, and for some years went through the country, and attended the fairs as an itinerant bookseller. There is great reason to believe that he engaged in this new species of traffic, more with a view to the improvement of his mind than for any pecuniary emolument. Formed by nature for literature, he possessed a peculiar talent for acquiring languages with amazing facility. Whether from a desire to understand the Scriptures in their original languages, or from being informed that these languages are the parents of many others, he began his philological pursuits with the study of the Hebrew and Greek tongues; and, by a wonderful effort of genius and application, made himself so far master of these, without any kind of assistance, as to be able to interpret the Hebrew Bible and Greek Testament into English *ad aperturam libri*. At this time he did not know one word of Latin. Sensible that he could make no great progress in learning, without the knowledge of at least the grammar of that language, he made application to the parish schoolmaster for his assistance. Some time afterwards, he was encouraged to prosecute his studies at the University of St Andrew's. An unexampled proficiency in every branch of literature recommended him to the esteem of the professors; and an uncommon fund of wit and pleasantry rendered him, at the same time, the favourite of all his fellow students, some of whom speak of him to this day with an enthusiastic degree of admiration and respect. About this period some very humorous poetical pieces of his composition were published in the Scots Magazine. Before he had finished his third session, or term, at St Andrew's, on an application to the College by the master of the school of Dunkeld for an usher, Mr Stone was recommended as the best qualified for that office; and about two or three years after, the master being removed to Perth, Mr Stone, by the favour of his Grace the Duke of Atholl, who had conceived a high opinion of his abilities, was appointed his successor. Stone ‖ Stone.

When he first went to Dunkeld, he entertained but an unfavourable opinion of the Gaelic language, which he considered as nothing better than a barbarous inarticulate gibberish; but being bent on investigating the origin and descent of the ancient Scots, he suffered not his prejudices to make him neglect the study of their primitive tongue. Having, with his usual assiduity and success, mastered the grammatical difficulties which he encountered, he set himself to discover something of the true genius and character of the language. He collected a number of ancient poems, the production of Irish or Scottish bards, which, he said, were daring, innocent, passionate, and bold. Some of these poems were translated into English verse, which several persons now alive have seen in manuscript, before Mr Macpherson published any of his translations from Ossian.

He died while he was writing and preparing for the press a treatise, intitled, "An Inquiry into the Original of the Nation and Language of the ancient Scots, with Conjectures about the Primitive State of the Celtic and other European Nations;" an idea which could not have been conceived by an ordinary genius. In this treatise he proves that the Scots drew their original, as well as their language, from the ancient Gauls. Had Mr Stone lived to finish this work, which discovers great ingenuity, immense reading, and indefatigable industry, it would have thrown light upon the dark and early periods of the Scottish history, as he opens a new and plain path for leading us through the unexplored labyrinths of antiquity. But a fever put an end to his life, his labours, and his usefulness, in the year 1757, being then only in the 30th year of his age. He left, in manuscript, a much esteemed and well-known allegory, intitled "The Immortality of Authors," which has been published and often reprinted since his death, and will be a lasting monument of a lively fancy, sound judgement, and correct taste. It was no small ornament of this extraordinary character, that he paid a pious regard to his aged mother, who survived him two years, and received an annual pension from the Dutchess of Atholl as a testimony of respect to the memory of her son.

STONEHIVE, or Stonehaven, a small town in the county of Kincardine, in Scotland, 15 miles south from Aberdeen. It was built in the time of Charles II. and stands at the foot of some high cliffs, in a small bay, with a rocky bottom, opening a little in one part, so that small vessels may find admittance, but only at high water. A pier laps over this harbour from the north side to secure them after their entrance. The town contains about 800 inhabitants. The manufactures are sail-cloths and Osnaburghs, knit worsted and thread stockings.

STONES, in natural history, bodies which are insipid, not ductile, nor inflammable, nor soluble in water. But as this is the definition given of earths by chemists and naturalists, we must refer the reader to the articles Earth, and Mineralogy, Part II. class 1. for a view

Stones

view of the claſſification of ſtones. Here we will only make a few obſervations concerning their natural hiſtory.

As philoſophers have perplexed themſelves much about the origin and formation of the earth (a ſubject certainly far beyond the ken of the human intellect, at leaſt if we believe that it was made by the Almighty power of God), ſo they have alſo propoſed theories to explain the origin of ſtones. When philoſophers limit their inquiries within the boundaries of ſcience, where they are led by the ſober and ſafe conduct of obſervation and experiment, their concluſions may be ſolid and may be uſeful; but when, throwing experiment and obſervation aſide, they rear a theory upon an airy nothing, or upon a ſingle detached fact, their theories will vaniſh before the touch of true philoſophy as a romantic palace before the rod of the enchanter. Sometimes from whim, or caprice, or vanity, they attempt to confound every thing: They wiſh to prove that the ſoul is mere matter, that plants are animals, and that foſſils are plants, and thus would baniſh two ſubſtances, ſpirit and dead matter, entirely from the world; as if the Author of Nature were actuated by ſordid views of parſimony in the works of creation, though we evidently ſee that a generous profuſion is one of the characteriſtic marks of theſe works. We leave the taſk of confounding the different claſſes of being to thoſe philoſophers whoſe minds are too contracted to comprehend a great variety of being at one view, or who prefer novelty to every thing elſe. We content ourſelves with the old opinion, that the ſoul is a ſpiritual ſubſtance; that plants are plants, and that ſtones are ſtones.

We have been led into theſe remarks by finding that ſome philoſophers ſay that ſtones are vegetables; that they grow and increaſe in ſize like a plant. This theory, we believe, was firſt offered to the world by M. Tournefort, in the year 1702, after returning from his travels in the eaſt. It was founded on a curious fact. In ſurveying the labyrinth of Crete, he obſerved that the names which viſitors had engraved upon the rock were not formed of hollow but of prominent letters like baſſo relievos. He ſuppoſes that theſe letters were at firſt hollowed out by knives; that the hollows have ſince been filled up by the growth of the ſtone; and hence he concludes that ſtones vegetate. We wiſh we were fully aſſured of the fact that the letters were at firſt hollowed, before we attempt to account for their prominency. But even allowing the ſuppoſition to be true that they were at firſt hollow, we reply it is only a ſingle fact, and that it is altogether unphiloſophical to deduce a general ſyſtem from a ſingle fact. Stones.

In the *ſecond* place, this protuberancy of the characters is very improperly called vegetation, for it is not produced by a proceſs in any reſpect like the vegetation of a plant. Vegetation ſuppoſes veſſels containing fluids and growth by expanſion; but who ever heard of veſſels in a ſtone, of fluids moving in them, or of the different parts expanding and ſwelling like the branch or trunk of a tree? Even the fact which Tournefort mentions proves nothing. He does not pretend to ſay, that the rock itſelf is increaſing, but only that a few ſmall hollows are filled with new ſtony matter, which riſes a little above the ſurrounding ſurface of the rock. This matter evidently has been once liquid, and at length has congealed in the channel into which it had run.—But is not this eaſily explained by a common proceſs, the formation of ſtalactites? When water charged with calcareous matter is expoſed to the action of air, the water evaporates, and leaves the calcareous earth behind, which hardens and becomes like a ſtone.

Having thus examined the principal fact upon which M. Tournefort founds his theory, it is unneceſſary to follow him minutely through the reſt of his ſubject.—He compares the accretion of matter in the labyrinth to the conſolidation of a bone when broken, by a callus formed of the extravaſated nutritious juice. This obſervation is thought to be confirmed, by finding that the projecting matter of the letters is whitiſh and the rock itſelf greyiſh. But it is eaſy to find compariſons. The difficulty, as Pope ſays, is to apply them. The reſemblance between the filling up of the hollow of a ſtone, and the conſolidation of a broken bone by a callus, we confeſs ourſelves not philoſophers enough to ſee. Were we writing poetry in bad taſte, perhaps it might appear. The circumſtance, that the prominent matter of the letters is whitiſh, while the rock is greyiſh, we flatter ourſelves ſtrengthens our ſuppoſition that it conſiſts of a depoſition of calcareous matter. Upon the whole, we conclude, we hope logically, that no ſuch theory as this, that ſtones are vegetables, can be drawn from the ſuppoſed fact reſpecting the labyrinth. We have to regret, that the account which we have ſeen of the ſubject is ſo imperfect, that we have not ſufficient materials for a proper inveſtigation. Tournefort has not even told us of what kind of ſtone or earth the accretion conſiſts; yet this ſingle information would probably have decided the queſtion (A).

Artificial

(A) To give a more diſtinct notion of Tournefort's theory, we ſhall ſubjoin his concluſions: From theſe obſervations (he ſays) it follows, that there are ſtones which grow in the quarries, and of conſequence that are fed; that the ſame juice which nouriſhes them ſerves to rejoin their parts when broken; juſt as in the bones of animals, and the branches of trees, when kept up by bandages; and, in a word, that they vegetate. There is, then (he ſays), no room to doubt but that they are organized; or that they draw their nutritious juice from the earth. This juice muſt be firſt filtrated and prepared in their ſurface, which may be here eſteemed as a kind of bark; and hence it muſt be conveyed to all the other parts. It is highly probable the juice which filled the cavities of the letters was brought thither from the bottom of the roots; nor is there any more difficulty in conceiving this than in comprehending how the ſap ſhould paſs from the roots of our largeſt oaks to the very extremities of their higheſt branches. Some ſtones, then (he concludes), muſt be allowed to vegetate and grow like plants: but this is not all; (he adds), that probably they are generated in the ſame manner; at leaſt, that there are abundance of ſtones whoſe generation is inconceivable, without ſuppoſing that they come from a kind of ſeeds, wherein the organical parts of the ſtones are wrapped up as thoſe of the largeſt plants are in their ſeeds.

Stone.

Artificial STONE. See STUCCO.

Elaſtic STONE. See *Elaſtic* MARBLE.

Philoſopher's STONE. See *Philosopher's* STONE.

Precious STONES. See GEM.

Rocking STONE, or *Logan*, a ſtone of a prodigious ſize, ſo exactly poiſed, that it would rock or ſhake with the ſmalleſt force. Of theſe ſtones the ancients give us ſome account. Pliny ſays, that at Harpaſa, a town of Aſia, there was a rock of ſuch a wonderful nature, that if touched with the finger it would ſhake, but could not be moved from its place with the whole force of the body*. Ptolemy Hepheſtion mentions† a gygonian ſtone near the ocean, which was agitated when ſtruck by the ſtalk of an aſphodel, but could not be removed by a great exertion of force. The word *gygonius* ſeems to be Celtic; for *gwingog* ſignifies *motitans*, the rocking-ſtone.

* Lib. ii. c. 69.
† Lib. iii. c. 3.

Many rocking ſtones are to be found in different parts of this iſland; ſome natural, others artificial, or placed in their poſition by human art. In the pariſh of St Leven, Cornwall, there is a promontory called *Caſtle Treryn*. On the weſtern ſide of the middle group, near the top, lies a very large ſtone, ſo evenly poiſed that any hand may move it from one ſide to another; yet it is ſo fixed on its baſe, that no lever nor any mechanical force can remove it from its preſent ſituation. It is called the *Logan-ſtone*, and is at ſuch a height from the ground that no perſon can believe that it was raiſed to its preſent poſition by art. But there are other rocking ſtones, which are ſo ſhaped and ſo ſituated, that there can be no doubt but they were erected by human ſtrength. Of this kind Borlaſe thinks the great *Quoit* or *Karn-lehau*, in the pariſh of Tywidnek, to be. It is 39 feet in circumference, and four feet thick at a medium, and ſtands on a ſingle pedeſtal. There is alſo a remarkable ſtone of the ſame kind in the iſland of St Agnes in Scilly. The under rock A is 10 feet 6 inches high, 47 feet round the middle, and touches the ground with no more than half its baſe. The upper rock C reſts on one point only, and is ſo nicely balanced, that two or three men with a pole can move it. It is eight feet ſix inches high, and 47 in circumference. On the top there is a baſon D hollowed out, three feet eleven inches in diameter at a medium, but wider at the brim, and three feet deep. From the globular ſhape of this upper ſtone, it is highly probable that it was rounded by human art, and perhaps even placed on its pedeſtal by human ſtrength. In Sithney pariſh, near Helſton, in Cornwall, ſtood the famous logan, or rocking ſtone, commonly called *Men Amber*, q. d. *Men an Bar*, or the *top-ſtone*. It was eleven feet by ſix and four high, and ſo nicely poiſed on another ſtone that a little child could move it, and all travellers who came this way deſired to ſee it. But Shrubſall, Cromwell's governor of Pendennis, with much ado cauſed it to be undermined, to the great grief of the country. There are ſome marks of the tool on it, and, by its quadrangular ſhape, it was probably dedicated to Mercury.

Plate CCCCLXXII. fig. 7.

Borlaſe, chap. iv. p. 181.

That the rocking ſtones are monuments erected by the Druids cannot be doubted; but tradition has not informed us for what purpoſe they were intended. Mr Toland thinks that the Druids made the people believe that they alone could move them, and that by a miracle; and that by this pretended miracle they condemned or acquitted the accuſed, and brought criminals to confeſs what could not otherwiſe be extorted from them. How far this conjecture is right we ſhall leave to thoſe who are deeply verſed in the knowledge of antiquities to determine.

Stone.

Sonorous STONE, a kind of ſtone remarkable for emitting an agreeable ſound when ſtruck, and much uſed in China for making muſical inſtruments which they call *king*.

The various kinds of ſonorous ſtones known in China differ conſiderably from one another in beauty, and in the ſtrength and duration of their tone; and what is very ſurpriſing, is, that this difference cannot be diſcovered either by the different degrees of their hardneſs, weight, or fineneſs of grain, or by any other qualities which might be ſuppoſed to determine it. Some ſtones are found remarkably hard, which are very ſonorous; and others exceedingly ſoft, which have an excellent tone; ſome extremely heavy emit a very ſweet ſound; and there are others as light as pumice-ſtone which have alſo an agreeable ſound.

The chemiſts and naturaliſts of Europe have never yet attempted to diſcover, whether ſome of our ſtones may not have the ſame properties as the ſonorous ſtones of the extremities of Aſia. It however appears, that the Romans were formerly acquainted with a ſonorous ſtone of the claſs of *hiang-che*. Pliny (ſays the Abbé du Bos, in his Reflections on Poetry and Painting, when ſpeaking of curious ſtones) obſerves that the ſtone called *chalcophonas*, or *brazen ſound*, is black; and that, according to the etymology of its name, it ſends forth a ſound much reſembling that of braſs when it is ſtruck. The paſſage of Pliny is as follows: *Chalcophonas nigra eſt; ſed eliſo æris tinnitum reddit.*

Some ſonorous ſtones were at length ſent into France, and the late Duke de Chaulnes examined them with particular attention. The following are ſome of his obſervations: "The Academy of Sciences, Mr Romé de Liſle, and ſeveral other learned mineralogiſts, when aſked if they were acquainted with the black ſtone of which the Chineſe king was made, for anſwer cited the paſſage of Pliny mentioned by Boethius de Bott, Linnæus, and in the Dictionary of Bomare, and added what Mr Anderſon ſays in his Natural Hiſtory of Iceland reſpecting a bluiſh kind of ſtone which is very ſonorous. As the black ſtone of the Chineſe becomes of a bluiſh colour when filed, it is probably of the ſame ſpecies. None of the reſt who were conſulted had ever ſeen it. The Chineſe ſtone has a great reſemblance at firſt ſight to black marble, and like it is calcareous; but marble generally is not ſonorous. It alſo externally reſembles touchſtone, which is a kind of baſaltes, and the baſaltes found near volcanos; but theſe two ſtones are vitrifications."

The duke next endeavoured to procure ſome information from the ſtone-cutters. They all replied, that blue-coloured marble was very ſonorous, and that they had ſeen large blocks of it which emitted a very ſtrong ſound; but the duke having ordered a king to be conſtructed of this kind of ſtone, it was found that it did not poſſeſs that property. By trying the black marble of Flanders, a piece was at length found which emitted an agreeable ſound: it was cut into a king, which is almoſt as ſonorous as thoſe of China. All theſe obſerva-

Stone. tions give us reaſon to believe that the ſtones of which the king are formed are nothing elſe but a black kind of marble, the conſtituent parts of which are the ſame as thoſe of the marble of Europe, but that ſome difference in their organization renders them more or leſs ſonorous.

Swine-Stone (*lapis ſuillus*), or *fetid ſtone*, ſo called from its exceſſively fetid ſmell, calcareous earth impregnated with petroleum. It is found, 1. Solid, with the particles ſcarcely viſible, of a black colour, as the marble does in Flanders, and in the province of Jutland in Sweden. 2. With viſible grains of a blackiſh brown colour, found likewiſe in ſome places of Sweden. 3. With coarſe ſcales, found alſo in Sweden. Great part of the limeſtones found in England belong to this claſs, and emit a very fetid ſmell when ſtruck violently, but it ſoon goes off in the fire.

Stone Marrow. See Clay, ſpecies 4.

Stone-Ware, a ſpecies of pottery ſo called from its hardneſs. See *Delft-Ware*, Porcelain, and Pottery.

Clay is a principal ingredient in pottery of all kinds which has the property of hardening in the fire, and of receiving and preſerving any form into which it is moulded. One kind of clay reſiſts the moſt violent action of the fire after being hardened to a certain degree, but is incapable of receiving a ſufficient degree of hardneſs and ſolidity. A ſecond kind aſſumes a hardneſs reſembling that of flint, and ſuch a compactneſs that veſſels made of it have a gloſſy appearance in their fracture reſembling porcelain. Theſe two ſpecies owe their peculiar properties of reſiſting heat without melting, to ſand, chalk, gypſum or ferruginous earth, which they contain. A third ſpecies of clay begins to harden with a moderate fire, and melts entirely with a ſtrong fire. It is of the ſecond ſpecies that ſtone-ware is made.

The moſt famous manufactory of ſtone-ware, as well as of other kinds of pottery, is at Burſlem in Staffordſhire. This can be traced with certainty at leaſt two centuries back; but of its firſt introduction no tradition remains. In 1686, as we learn from Dr Plot's Natural Hiſtory of Staffordſhire publiſhed in that year, only the coarſe yellow, red, black, and mottled wares, were made in this country; and the only materials employed for them appear to have been the different coloured clays which are found in the neighbourhood, and which form ſome of the meaſures or ſtrata of the coal-mines. Theſe coarſe clays made the body of the ware, and the glaze was produced by powdered lead-ore, ſprinkled on the pieces before firing, with the addition of a little manganeſe for ſome particular colours. The quantity of goods manufactured was at that time ſo inconſiderable, that the chief ſale of them, the Doctor ſays, was "to poor crate-men, who carried them on their backs all over the country."

Anderſon's Commerce, vol. iv.

About the year 1690, two ingenious artiſans from Germany, of the name of Eller, ſettled near Burſlem, and carried on a ſmall work for a little time. They brought into this country the method of glazing ſtone-ware, by caſting ſalt into the kiln while it is hot, and ſome other improvements of leſs importance; but finding they could not keep their ſecrets to themſelves, they left the place rather in diſguſt. From this time various kinds of ſtone-ware, glazed by the fumes of ſalt in the manner above-mentioned, were added to the wares before made. The white kind, which afterwards became, and for many ſucceeding years continued, the ſtaple branch of pottery, is ſaid to have owed its origin to the following accident. A potter, Mr Aſtbury, travelling to London, perceived ſomething amiſs with one of his horſe's eyes, an hoſtler at Dunſtable ſaid he could ſoon cure him, and for that purpoſe put a common black flint ſtone into the fire. The potter obſerving it, when taken out, to be of a fine white, immediately conceived the idea of improving his ware by the addition of this material to the whiteſt clay he could procure: accordingly he ſent home a quantity of the flint ſtones of that country, where they are plentiful among the chalk, and by mixing them with tobacco-pipe clay, produced a white ſtone-ware much ſuperior to any that had been ſeen before. Stone.

Some of the other potters ſoon diſcovered the ſource of this ſuperiority, and did not fail to follow his example. For a long time they pounded the flint ſtones in private rooms by manual labour in mortars; but many of the poor workmen ſuffered ſeverely from the duſt of the flint getting into their lungs, and producing dreadful coughs, conſumptions, and other pulmonary diſorders. Theſe diſaſters, and the increaſed demand for the flint powder, induced them to try to grind it by mills of various conſtructions; and this method being found both effectual and ſafe, has continued in practice ever ſince. With theſe improvements, in the beginning of the preſent century, various articles were produced for tea and coffee equipages. Soon after attempts were made to furniſh the dinner table alſo; and before the middle of the century, utenſils for the table were manufactured in quantity as well for exportation as home conſumption.

But the ſalt glaze, the only one then in uſe for this purpoſe, is in its own nature ſo imperfect, and the potters, from an injudicious competition among themſelves for cheapneſs, rather than excellence, had been ſo inattentive to elegance of form and neatneſs of workmanſhip, that this ware was rejected from the tables of perſons of rank; and about the year 1760, a white ware, much more beautiful and better glazed than ours, began to be imported in conſiderable quantities from France.

This inundation of a foreign manufacture, ſo much ſuperior to any of our own, muſt have had very bad effects upon the potteries of this kingdom, if a new one, ſtill more to the public taſte, had not appeared ſoon after. In the year 1763, Mr Joſiah Wedgwood, who had already introduced ſeveral improvements into this art, invented a ſpecies of earthen ware for the table quite new in its appearance, covered with a rich and brilliant glaze, bearing ſudden alternations of heat and cold, manufactured with eaſe and expedition, and conſequently cheap, and having every requiſite for the purpoſe intended. To this new manufacture the queen was pleaſed to give her name and patronage, commanding it to be called *Queen's ware*, and honouring the inventor by appointing him her majeſty's potter.

The common clay of the country is uſed for the ordinary ſorts; the finer kinds are made of clay from Devonſhire and Dorſetſhire, chiefly from Biddeford; but the flints from the Thames are all brought rough by ſea, either to Liverpool or Hull, and ſo by Burton. There is no conjecture formed of the original rea-

Stone, Stonehenge.

ſon of fixing the manufacture in this ſpot, except for the convenience of plenty of coals, which abound under all the country.

The flints firſt are ground in mills, and the clay prepared by breaking, waſhing, and ſifting, and then they are mixed in the requiſite proportions. The flints are bought firſt by the people about the country, and by them burnt and ground, and ſold to the manufacturers by the peck.

The mixture is then laid in large quantities on kilns to evaporate the moiſture; but this is a nice work, as it muſt not be too dry; next it is beat with large wooden hammers, and then is in order for throwing, and is moulded into the forms in which it is to remain: this is the moſt difficult work in the whole manufacture. A boy turns a perpendicular wheel, which by means of thongs turns a ſmall horizontal one, juſt before the thrower, with ſuch velocity, that it twirls round the lump of clay he lays on it into any form he directs it with his fingers.

There are 300 houſes which are calculated to employ, upon an average, twenty hands each, or 6000 in the whole; but of all the variety of people that work in what may be called the preparation for the employment of the immediate manufacturers, the total number cannot be much ſhort of 10,000, and it is increaſing every day. Large quantities are exported to Germany, Ireland, Holland, Ruſſia, Spain, the Eaſt Indies, and much to America; ſome of the fineſt ſorts to France.

Stone in the Bladder. See Medicine, n° 400. Surgery-*Index*; and Alkali, n° 17, 18, 19.

Stone, in merchandize, denotes a certain weight for weighing commodities. A ſtone of beef at London is the quantity of eight pounds: in Herefordſhire 12 pounds: in the North 16 pounds. A ſtone of glaſs is five pounds; of wax eight pounds. A ſtone of wool (according to the ſtatute of 11 Hen. VII.) is to weigh 14 pounds; yet in ſome places it is more, in others leſs; as in Glouceſterſhire 15 pounds; in Herefordſhire 12 pounds. Among horſe-courſers a ſtone is the weight of 14 pounds.

The reaſon of the name is evident. Weights at firſt were generally made of ſtone. See Deut. xxv. 13. where the word אבן, tranſlated *weight*, properly ſignifies a *ſtone*.

Stone-Chatter, in ornithology. See Motacilla.

STONEHENGE, a celebrated monument of antiquity, ſtands in the middle of a flat area near the ſummit of a hill ſix miles diſtant from Saliſbury. It is incloſed by a circular double bank and ditch near 30 feet broad, after croſſing which we aſcend 30 yards before we reach the work. The whole fabric conſiſted of two circles and two ovals. The outer circle is about 108 feet diameter, conſiſting when entire of 60 ſtones, 30 uprights and 30 impoſts, of which remain only 24 uprights, 17 ſtanding and 7 down, $3\frac{1}{2}$ feet aſunder, and 8 impoſts. Eleven uprights have their 5 impoſts on them by the grand entrance. Theſe ſtones are from 13 to 20 feet high. The leſſer circle is ſomewhat more than 8 feet from the inſide of the outer one, and conſiſted of 40 leſſer ſtones (the higheſt 6 feet), of which only 19 remain, and only 11 ſtanding: the walk between theſe two circles is 300 feet in circumference. The Adytum or Cell is an oval formed of 10 ſtones (from 16 to 22 feet high), in pairs, with impoſts, which Dr Stukeley calls *trilithons*, and above 30 feet high, riſing in height as they go round, and each pair ſeparate, and not connected as the outer pair; the higheſt 8 feet. Within theſe are 19 more ſmaller ſingle ſtones, of which only 6 are ſtanding. At the upper end of the Adytum is the altar, a large ſlab of blue coarſe marble, 20 inches thick, 16 feet long, and 4 broad; preſſed down by the weight of the vaſt ſtones that have fallen upon it. The whole number of ſtones, uprights, impoſts, and altar, is exactly 140. The ſtones are far from being artificial, but were moſt probably brought from thoſe called the *Grey Weathers* on Marlborough Downs, 15 or 16 miles off; and if tried with a tool they appear of the ſame hardneſs, grain, and colour, generally reddiſh. The heads of oxen, deer, and other beaſts, have been found on digging in and about Stonehenge; and human bones in the circumjacent barrows. There are three entrances from the plain to this ſtructure, the moſt conſiderable of which is from the north-eaſt, and at each of them were raiſed on the outſide of the trench two huge ſtones with two ſmaller within parallel to them.

Stone-henge.

It has been long a diſpute among the learned, by what nation, and for what purpoſe, theſe enormous ſtones were collected and arranged. The firſt account of this ſtructure we meet with is in Geoffroy of Monmouth, who, in the reign of King Stephen, wrote the hiſtory of the Britons in Latin. He tells us, that it was erected by the counſel of Merlin the Britiſh enchanter, at the command of Aurelius Ambroſius the laſt Britiſh king, in memory of 460 Britons who were murdered by Hengiſt the Saxon. The next account is that of Polydore Virgil, who ſays that the Britons erected this as a ſepulchral monument of Aurelius Ambroſius. Others ſuppoſe it to have been a ſepulchral monument of Boadicea the famous Britiſh Queen. Inigo Jones is of opinion, that it was a Roman temple; from a ſtone 16 feet long, and four broad, placed in an exact poſition to the eaſtward, altar-faſhion. Mr Charlton attributed it to the Danes, who were two years maſters of Wiltſhire; a tin tablet, on which were ſome unknown characters, ſuppoſed to be Punic, was digged up near it in the reign of Henry VIII. but is loſt; probably that might have given ſome information reſpecting its founders. Its common name, *Stonehenge*, is Saxon, and ſignifies a "ſtone gallows," to which thoſe ſtones, having tranſverſe impoſts, bear ſome reſemblance. It is alſo called in Welch *choir gour*, or "the giants dance."

Mr Groſe thinks that Dr Stukeley has completely proved this ſtructure to have been a Britiſh temple in which the Druids officiated. He ſuppoſes it to have been the metropolitan temple of Great Britain, and tranſlates the words *choir gour* "the great choir or temple." The learned Mr Bryant is of opinion that it was erected by a colony of Cuthites probably before the time of the Druids; becauſe it was uſual with them to place one vaſt ſtone upon another for a religious memorial; and theſe they often placed ſo equably, that even a breath of wind would ſometimes make them vibrate. Of ſuch ſtones one remains at this day in the pile of Stonehenge. The ancients diſtinguiſhed ſtones erected with a religious view, by the name of *amber*; by which was ſignified any thing ſolar and divine. The Grecians called them πετραι αμβροσιαι, *petræ ambroſiæ*. Stonehenge, according

Gough's edition of Cambden's Britannia, vol. i. p. 107.

Groſe's Antiquities, vol. vi. p. 40.

Stook ‖ Stove.

cording to Mr Bryant, is compoſed of theſe amber ſtones: hence the next town is denominated *Ambreſbury*; not from a Roman Ambroſius, for no ſuch perſon ever exiſted, but from the *ambroſiæ petræ*, in whoſe vicinity it ſtood. Some of theſe were rocking ſtones; and there was a wonderful monument of this ſort near Penzance in Cornwall, which ſtill retains the name of *main-amber*, or the ſacred ſtones. Such a one is mentioned by Apollonius Rhodius, ſuppoſed to have been raiſed in the time of the Argonautæ, in the iſland Tenos, as the monument of the two-winged ſons of Boreas, ſlain by Hercules; and there are others in China and other countries.

STOOK, a term uſed in many parts of the kingdom for a ſhock of corn containing 12 ſheaves.

STOOL, in medicine, an evacuation or diſcharge of the fæces by the anus.

Stool, in mining, is uſed when the miners leave off digging deeper, and work in the ends forward. The end before them is called the *ſtool*.

Stool, in ſhip-building, the name of the ſupporters of the poop and top lanterns.

STOOPING, in falconry, is when a hawk, being upon her wings at the height of her pitch, bends down violently to take the fowl.

STOPPERS, in a ſhip, certain ſhort pieces of rope, which are uſually knotted at one or both ends, according to the purpoſe for which they are deſigned. They are either uſed to ſuſpend any heavy body, or to retain a cable, ſhroud, &c. in a fixed poſition. Thus, the anchors, when firſt hoiſted up from the ground, are hung to the cat-head by a ſtopper attached to the latter, which paſſing through the anchor-ring, is afterwards faſtened to the timber-head; and the ſame rope ſerves to faſten it on the bow at ſea; or to ſuſpend it by the ring which is to be ſunk from the ſhip to the bottom. The ſtoppers of the cable have a large knot and a laniard at one end, and are faſtened to a ring-bolt in the deck by the other. They are attached to the cable by the laniard, which is faſtened ſecurely round both by ſeveral turns paſſed behind the knot, or about the neck of the ſtopper; by which means the cable is reſtrained from running out of the ſhip when ſhe rides at anchor.

The ſtoppers of the ſhroud have a knot and a laniard at each end. They are only uſed when the ſhrouds are cut aſunder in battle, or diſabled by tempeſtuous weather; at which time they are laſhed, in the ſame manner as thoſe of the cables, to the ſeparated parts of the ſhroud, which are thereby reunited, ſo as to be fit for immediate ſervice. This, however, is only a temporary expedient.

STOPS. See Punctuation; and Scripture, n° 136.

STORAX. See Styrax.

STORK, in ornithology. See Ardea.

STOVE for heating apartments, greenhouſes, hothouſes, fruit-walls, &c.

When treating of the mechanical properties of air, we explained in ſufficient detail the manner in which the expanſion produced in a maſs of air by heat produces that motion up our chimneys which is called the draught of the chimney; and, in the article Smoke, we conſidered the circumſtances which tend to check, to promote, or to direct this current, ſo as to free us from the ſmoke and vitiated air which neceſſarily accompanies the conſumption of the fuel. In Pneumatics we alſo attended to the manner in which our fires immediately operate in warming our apartments. At preſent, when about to deſcribe a method of warming intrinſically different, we muſt pay ſome more attention to the diſtinguiſhing circumſtance. Without pretending to explain the phyſical connection of heat and light, it may ſuffice to obſerve, that heat, as well as light, is communicated to diſtant bodies in an inſtant by radiation. A perſon paſſing haſtily by the door of a glaſs-houſe feels the glow of heat in the very moment he ſees the dazzling light of the furnace mouth, and it is interrupted by merely ſcreening his face with his hand. In this way is an apartment partly warmed by an open fire; and we avoid the oppreſſive heat by ſitting where the fire is not ſeen, or by interpoſing a ſcreen. We are apt to connect this ſo ſtrongly in the imagination with the light emitted by the fire, that we attribute the heat to the immediate action of the light. But this opinion is ſhown to be gratuitous by a curious experiment made before the Royal Society by Dr Hooke, and afterwards, with more care and accurate examination, by Mr Scheele. They found, that by bringing a plate of the moſt tranſparent glaſs briſkly between the fire and one's face, the heat is immediately intercepted without any ſenſible diminution of the light. Scheele, by a very pretty inveſtigation, diſcovered that the glaſs made the ſeparation, and did it both in refraction and reflection; for he found, that when the light of the ſame fire was collected into a focus by means of a poliſhed metal concave ſpeculum, a thermometer placed there was *inſtantly* affected. But if we employ a glaſs ſpeculum foiled in the uſual manner with quickſilver, of the ſame diameter and focal diſtance, and of equally brilliant reflection, there is hardly any ſenſible heat produced in the focus, and the thermometer muſt remain there for a very long while before it is ſenſibly affected. When we repeated this curious experiment, we found, that after the glaſs has remained a long while in this poſition, whether tranſmitting or reflecting the light, it loſes in a great meaſure its power of intercepting the heat. By varying this obſervation in many of its circumſtances, we think ourſelves entitled to conclude, that the glaſs abſorbs the heat which it intercepts, and is very quickly heated by the abſorption. While it riſes in its own temperature, it intercepts the heat powerfully; but when it is, as it were, ſaturated, attracting no more than what it immediately imparts to the air in corporeal contact with it, the heat paſſes freely through along with the light. If the glaſs be held ſo near the fire that the ſurrounding air is very much heated, no ſenſible interruption of heat is perceived after the glaſs is thus ſaturated. We found the cheek more quickly ſenſible than the thermometer of this inſtantaneous radiation of the heat which accompanies the light, or is ſeparated from it in this experiment. It is a very inſtructive experiment in the phyſiology of heat.

Stove.

We cannot ſay how far this radiation of heat may extend, nor whether the accompanyment of light is abſolutely neceſſary. The mathematician proceeds on the ſuppoſition that it extends as far as the radiation of light, and that, being alſo rectilineal, the denſity of the heat is proportional to that of the light. But theſe notions are ſomewhat gratuitous; and there are

appearances

Stove. appearances which render them doubtful. When with a lens of an inch in diameter we form a focus on a piece of black unpoliſhed marble of an inch diameter, the mathematician muſt allow that no more rays fall on the marble than if the lens were away: therefore the marble ſhould be equally warmed in either caſe. But it is by no means ſo, as we have repeatedly found by expoſing it during equal times, and then dropping it into water. The water which is heated by the marble on which the focus has been formed will be found to have acquired from it much more heat than from the other. The tops of loſty mountains which are never ſhaded by clouds, but enjoy perpetual ſunſhine and ſerenity, inſtead of being warmer than the valleys below, are covered with never-melting ſnow; and we have ſome grounds to ſuſpect that the genial influence of the ſun requires the co-operation of the atmoſphere, and to doubt whether there is any warmth at the moon, on which no atmoſphere like ours can be obſerved. Perhaps the heat which cheers us, and fertilizes our earth, is chemically ſeparated from our atmoſphere by its elective attraction for the light of the ſun. Our ſucceſſors in the ſtudy of meteorology need not fear that the ſubject of their reſearch will be ſoon deprived of ſcientific allurements. We know but little of it after all the progreſs we have made during this laſt century, and it ſtill preſents an ample field of diſcuſſion.

We ſaid that the accompanyment of light is not demonſtrably neceſſary. We are certain that heat may be imparted without any ſenſible light, in a manner which we can hardly ſuppoſe any thing but radiation. If a piece of very hot iron be placed a little without the principal focus of a metallic concave ſpeculum, and a very ſenſible air-thermometer be placed in its conjugate focus, it will inſtantly ſhow an elevation of temperature, although the iron is quite imperceptible to an eye which has even been a long while in the dark. No ſuch riſe of temperature is obſerved if the thermometer be placed a little to one ſide of the focus of the ſpeculum; therefore the phenomenon is preciſely ſimilar to the radiation of light. We are obliged therefore to acknowledge that the heat is radiated in this experiment in the ſame way that light is in the common optical experiments.

Although this is the moſt uſual way that we in this country employ fuel for warming our apartments, it is by no means the only way in which the heat diffuſed from this fuel may be imparted to diſtant bodies. It is not even the moſt effectual method; it is diffuſed alſo by immediate communication to bodies in contact. The air in immediate contact with the burning fuel is heated, and imparts ſome of its heat to the air lying beyond it, and this is partly ſhared with the air which is ſtill farther off; and this diffuſion, by communication *in contactu*, goes on till the remote air contiguous to the walls, the floor, the ceiling, the furniture, the company, all get a ſhare of it in proportion to their attractions and their capacities. And as the air is thus continually ſupplied, and continually gives out heat, the walls, &c. become gradually warmer, and the room becomes comfortable and pleaſant. But we apprehend that no great proportion of the heat actually acquired by the room is communicated in this way. This diffuſion by contact is but ſlow, eſpecially in air which is very dry; ſo ſlow indeed, that the air in the immediate neighbourhood of the fuel is hurried up the chimney before it has time to impart any of the heat received in contact. We know that the time employed in diffuſing itſelf in this way through ſtagnant air to any moderate diſtance is very conſiderable. We imagine therefore that the heat communicated to our rooms by an open fire is chiefly by radiation, but in a way ſomething different from what we mentioned before. We imagine, that as the piece of glaſs in Dr Hooke's experiment abſorbs the heat, ſo the whole maſs of air which fills the room intercepts the radiated heat in every part of the room where the fire is ſeen, and is as it were ſaturated with it throughout, and ready to impart it to every body immerſed in it. We cannot otherwiſe account for the *equability* of the heat in the different parts of the room. Mere radiation on the ſolid bodies would warm them in the inverſe duplicate ratio of their diſtances from the fire; and diffuſion by contact, if compatible with the rapid current up the chimney, would heat the room ſtill more unequably. Recollect how ſlowly, and with what rapid diminution of intenſity, the colour of blue vitriol is communicated to water even to a very ſmall diſtance. But becauſe all parts of the air of the room abſorb radiated heat, what is ſaturated at a higher temperature, being nearer to the fire, riſes to the ceiling, ſpreads outwards along the ceiling, and has its place ſupplied by the air, which is thus puſhed towards the fire from the places which are not directly illuminated. Stove.

Far different is the method of warming the room by a ſtove. Here the radiation, if any, is very feeble or ſcanty; and if a paſſage were allowed up the chimney for the warmed air, it would be quickly carried off. This is well known to the Engliſh who reſide in the cold climates of St Peterſburgh, Archangel, &c. They love the exhilarating flutter of an open fire, and often have one in their parlour; but this, ſo far from warming the room during the extreme cold weather, obliges them to heat their ſtoves more frequently, and even abſtracts the heat from a whole ſuite of apartments. But all paſſages this way is ſhut up when we warm a room by ſtoves. The air immediately contiguous to the ſtove is heated by contact, and this heat is gradually, though ſlowly, diffuſed through the whole room. The diffuſion would however be very ſlow indeed, were it not for the great expanſibility of air by heat. But the air ſurrounding the ſtove quickly expands and riſes to the ceiling, while the neighbouring air ſlides in to ſupply the place, nay is even puſhed in by the air which goes outwards aloft. Thus the whole air is ſoon mixed, and the room acquires almoſt an equal temperature throughout.

The warming by ſtoves muſt therefore be managed upon very different principles from thoſe adopted in the employment of open fires. The general principle is, 1*ſt*, To employ the fuel in the moſt effectual manner for heating the external part of the ſtove, which is immediately efficient in warming the contiguous air; and, 2*d*, To keep in the room the air already warmed, at leaſt as much as is conſiſtent with wholeſomeneſs and cleanlineſs.

The firſt purpoſe is accompliſhed by conducting the flue of the furnace round its external parts, or, in ſhort, by making every part of the flue external. Of all forms, that of a long pipe, returned backwards and forwards, up and down (provided only that the place of its

Stove. its laſt diſcharge be conſiderably higher than its entry from the fire-place), would be the moſt effectual. We have ſeen a very ſmall ſtove conſtructed in this way, the whole being incloſed in a handſome caſe of poliſhed iron plate, pierced and cut into elegant foliage like the cock of a watch, ſo that the odd looking pipes were completely concealed. Though only three feet long, one foot thick, and ſix feet high, it warmed a very lofty room of 24 feet by 18, and conſumed leſs than half the fuel of a ſtove of the more uſual make, which did not ſo fully warm a ſmaller chamber.

It would occupy a volume to deſcribe the immenſe variety of ſtoves which ingenuity or architectonic taſte has conſtructed. We ſhall content ourſelves with giving a ſpecimen of the two chief claſſes into which they may be diſtinguiſhed.

The air of a room may be equally warmed, either by applying it to the ſurface of a ſmall ſtove made very hot, or to the ſurface of a much larger ſtove more moderately heated. The firſt kind is chiefly uſed in Holland, Flanders, and the milder climates of Germany and Poland. The laſt are univerſally uſed in the frozen climates of Ruſſia and Sweden. The firſt are generally made of caſt-iron, and the laſt of brick-work covered with glazed tiles or ſtucco.

Plate CCCCLXXIV. Fig. 1. repreſents a ſmall German ſtove fully ſufficient for warming a room of 24 feet by 18. The baſe is about three feet broad and 14 inches deep, that is, from back to front, and ſix or ſeven feet high. The decoration is in the faſhion of that country; but the operative ſtructure of it will admit of any ſtyle of ornament. A, is the fire-place, and the wood or charred coal is laid on the bottom, which has no bars. Bars would admit the air too freely among the fuel, and would both conſume it too faſt and raiſe too great a heat. That no heat may be uſeleſsly expended, the ſole of the fire-place and the whole bottom of the ſtove is raiſed an inch or two above the floor of the room, and the air is therefore warmed by it in ſucceſſion, and riſes upwards. For the ſame reaſon the back of the ſtove is not in contact with the wall of the room, or of the niche in which it is placed. The fire-place is ſhut up by a door which fits cloſely to its caſe, and has a ſmall wicket at the bottom, whoſe aperture is regulated by a ſliding plate, ſo as to admit no more air than what ſuffices for ſlowly conſuming the fuel. The flame and heated air riſe to the top of the fire-place three or four inches above the arch or mantle-piece, and get out laterally by two narrow paſſages B, B, immediately below the top plate of the baſe. The current bends downward on each ſide, paſſes at C, C, under the partition plates which divide the two ſide chambers, and then riſes upwards through the outer diviſion of each, and paſſes through narrow ſlits D, D, in the top plate, and from thence along the two hollow piers E, E. The two lateral currents unite at the top of the arch, and go through the ſingle paſſage F into the larger hollow behind the eſcutcheon G. From this place it either goes ſtraight upwards into the vent in the wall by a pipe on the top of the ſtove, or it goes into the wall behind by a pipe inſerted in the back of the ſtove. The propriety of this conſtruction is very obvious. The current of hot air is applied to exterior parts of the ſtove everywhere except in the two ſide chambers of the baſe, where the partition-plates form one ſide of the canal. Even this might be avoided by making each of theſe ſide-chambers a detached hollow pillar. But this would greatly increaſe the trouble of conſtruction and joining together, and is by no means neceſſary. The arch H has a graceful appearance, and affords a very warm ſituation for any thing that requires it, ſuch as a drink in a ſick perſon's bed-chamber, &c. Perſons of a certain claſs uſe this place for keeping a diſh warm; nay, the lower part of the arch is frequently occupied by an incloſed chamber, where the heat riſes high enough even for dreſſing victuals, as will be eaſily imagined when we reflect that the ſole of it is the roof of the fire-place. Stove.

The ſtove now deſcribed is ſupplied with fuel and with air by the front door opening into the room. That there may be room for fuel, this middle part projects a few inches before the two ſide chambers. Theſe laſt, with the whole upper part of the ſtove, are not more than ten inches deep. The paſſages, therefore, from the fire-place are towards the back of it; ſo that if we have a mind to ſee the fire (which is always cheerful), the door may be thrown open, and there is no danger of the ſmoke coming out after the current has once warmed the upper part of the ſtove. When the ſtove is of ſuch dimenſions that the baſe is about two feet and a half or three feet high, the fire-place may be furniſhed with a ſmall grate in the Britiſh ſtyle. If the door is ſo hung that it can not only be thrown back, but liſted off its hinges, we have a ſtove grate of the compleateſt kind, fully adequate, in our mild climate, to warm a handſome apartment, even with an open fire; and when we hang on the door, and ſhut up the fire-place, a ſtove of the dimenſions already given is almoſt too much for a large drawing-room.

We have frequently remarked, that one ſide of theſe ſtoves grows much warmer than the other, and that it was difficult to prevent or remedy this; and we imagine that this is an unavoidable defect in all ſtoves with a double flue. It is ſcarcely poſſible to make the fire ſo equable in the fire-place, that one ſide ſhall not be a little warmer than the other, and a briſker current will then be produced in it. This muſt increaſe the conſumption of the fuel on this ſide, which will increaſe the current, will heat this ſide ſtill more, and thus go on continually till the fuel on this ſide is expended; after which the other ſide will obtain and increaſe the ſuperiority. The flue is made double, that the fire-place may occupy the middle of the front; and it will be difficult to gain this point of ſymmetry with one flue. The inconvenience may, however, be corrected by damping valves placed in ſome part of the upright funnels E, E.

In the colder winters on the continent, it is thought neceſſary to increaſe the effect by making the fire-place open to the back of the ſtove. Its mouth or door communicates with or is joined to an opening of the ſame dimenſions formed in the wall, and the door is on the other ſide in an antichamber or lobby. In Weſtphalia, and other places of Germany, the apartments are diſpoſed round a ſpacious lobby, into which all their fire-places open, and are there ſupplied with fuel. By this conſtruction it is plain that the air of the room, already warmed by the ſtove, is not carried off, and the room is more heated. But this method is very unfavourable to cheerfulneſs and health. The ſame air confined, and repeatedly

Stove. repeatedly breathed and compounded with all the volatile emanations of the room, quickly loſes that refreſhing quality that is ſo deſirable, and even ſo neceſſary for health. It is never renewed except by very partial admixtures when the room-doors are thrown open, and becomes diſagreeable to any perſon coming in from the open air; and in the houſes of the leſs opulent becomes really offenſive and nauſeous.

Something of this is unavoidable in all rooms heated by ſtoves. Even in our apartments in this iſland, perſons of delicate nerves are hurt by what they call the cloſe air of a room; and it is long before the ſmell of dinner is quite removed from a dining-room, notwithſtanding the copious current up the chimney. This muſt be incomparably more ſenſible in a room heated by a ſtove; and this inconvenience is peculiarly ſenſible with reſpect to the ſtove which we are conſidering at preſent, where we employ a ſmall ſurface heated to a great degree.

Such ſtoves are ſeldom made of any thing elſe than caſt-iron. This (in thoſe parts at leaſt which are in immediate contact with the fuel) is in a ſtate of continual calcination, and even throwing off ſcales. This indeed is not ſeen, becauſe it is the bottom or ſole of the fire-place which is ſo heated: but the effect on the air of the room is the ſame. The calcination of the iron is occaſioned by the combination of pure vital air with the iron. This is abſtracted from the general maſs of atmoſpheric air in the room, of which it uſually conſtitutes about $\frac{1}{5}$ths. By this abſtraction the remainder becomes leſs fit for ſupporting animal life or flame, and may even become highly deleterious. In every degree the remainder becomes leſs refreſhing, and grows dull and oppreſſive. This is always accompanied by a peculiar ſmell, which, though not diſguſting, is unpleaſant. It reſembles the ſmell of burnt feathers, or more exactly the ſmell we feel if we rub violently for ſome time the palms of our hands together when perfectly dry.

For ſimilar reaſons theſe iron ſtoves occaſion a ſickly ſmell, by burning every particle of duſt which falls on the hot parts; and if they be wiped with a woollen cloth, or any cloth not perfectly free from every kind of greaſy or oily matter, a ſmell is produced for a day or days afterwards; ſo that without the moſt ſcrupulous attention we ſuffer by our very cleanlineſs.

For ſuch reaſons we think that the ſtoves of brick-work covered with ſtucco or with glazed tiles are vaſtly preferable. Theſe are much uſed in the genteeler houſes in Flanders and Holland, where they are made in the moſt elegant forms, and decorated with beautiful ſculpture or enamel; but it is plain that they cannot be ſo effectual, nor equally warm a room with the ſame expence of fuel. Earthen ware, eſpecially when covered with porous ſtucco, is far inferior to metal in its power of conducting heat. If built of bricks, they muſt be vaſtly more bulky when the fire-place and flues are of the ſame dimenſions. The moſt perfect way of conſtructing them would certainly be to make them of pottery, in parts exactly fitted to each other, and joined by a proper cement. This mode of conſtructing would admit of every elegance of form or richneſs of ornament, and would not be ſo bulky as thoſe which are built of bricks. The great difficulty is to prevent their cracking by the heat. Different parts of the ſtove being of very different heats, they expand unequally, and there is no cement which can withſtand this, eſpecially when we recollect that the ſame heat which expands the baked earth cauſes the clay or cement, with which the parts of the ſtove are put together or covered, to contract. Accordingly thoſe earthen ware ſtoves ſeldom ſtand a winter or two without cracking in ſome place or other, even when ſtrengthened by iron hoops and cramps judiciouſly diſpoſed within them. Even hooping them externally, which would be very unſightly, will not prevent this; for nothing can reſiſt the expanſion and contraction by heat and cold. When a crack happens in a ſtove, it is not only unſightly, but highly dangerous; becauſe it may be ſo ſituated, that it will diſcharge into the room the air vitiated by the fire. Stove.

For theſe and other reaſons, we can ſcarcely hope to make ſtoves of brick-work or pottery which ſhall bear the neceſſary heat without cracking; and their uſe muſt therefore be confined to caſes where very moderate heat is ſufficient. We need not deſcribe their conſtruction. It is evident that it ſhould be more ſimple than that of iron ſtoves; and we imagine that in the very few caſes in which they are likely to be employed in this country, a ſingle fire-place and an arch over it, divided, if we pleaſe, by a partition or two of thin tile to lengthen the flue, will be quite enough. If the ſtove is made in whole or in part of potters ware, a baſe for the fire-place, with an urn, column, obeliſk, or pyramid above it, for increaſing the ſurface, will alſo be ſufficient. The failure commonly happens at the joinings, where the different pieces of a different heat, and perhaps of a different baking, are apt to expand unequally, and by working on each other one of them muſt give way. Therefore, inſtead of making the joints cloſe and uſing any cement, the upper piece ſhould ſtand in a groove formed in the undermoſt, having a little powdered chalk or clay ſprinkled over it, which will effectually prevent the paſſage of any air; and room being thus given for the unequal expanſion, the joint remains entire. This may be conſidered as a general direction for all furnace-work, where it is in vain to attempt to hinder the mutual working of the parts.

We have ſeen ſtoves in ſmall apartments at St Peterſburg, which were made internally of potters ware, in a great variety of forms, and then covered with a thick coat of ſtucco, finiſhed externally with the utmoſt elegance of ornament, and we were informed that they were very rarely ſubject to crack. They did not give much heat, on account of the very low conducting power of the porous ſtucco; but we imagine that they would be abundantly warm for a moderate room in this country.

When fitted up in theſe ſituations, and with theſe precautions, the brick or pottery ſtoves are incomparably more ſweet and pleaſant than the iron ones.

But in the intenſe colds of Ruſſia and Sweden, or even for very large rooms in this kingdom, ſtoves of theſe ſmall dimenſions are not ſufficiently powerful, and we muſt follow the practice of thoſe countries where they are made of great ſize, and very moderately heated. It is needleſs to deſcribe their external form, which may be varied at pleaſure. Their internal ſtructure is the ſame in all, and is diſtinctly deſcribed in PNEUMATICS, n° 364. We ſhall only enlarge a little on the

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Stove. peculiarities connected with the general principle of their conſtruction.

The ſtove is intended as a ſort of magazine, in which a great quantity of heat may be quickly accumulated, to be afterwards ſlowly communicated to the air of the room. The ſtove is therefore built extremely maſſive; and it is found that they are more powerful when coated with clay as wet as can be made to hang together. We imagine the reaſon of this to be, that very wet clay, and more particularly ſtucco, muſt be exceedingly porous when dry, and therefore a very ſlow conductor of heat. Inſtead of ſticking on the glazed tiles with no more clay or ſtucco than is ſufficient to attach them, each tile has at its back a ſort of box baked in one piece about two or three inches deep. It is repreſented in fig. 2. This is filled with mortar, and then ſtuck on the brick-work of the ſtove, which has a great number of iron pins or hooks driven into the joints, which may ſink into this clay and keep it firmly attached when dry. This coating, with the maſſive brick-work, forms a great maſs of matter to be heated by the fuel. The loweſt chamber, which is the fire-place, is ſomewhat wider, and conſiderably thicker than the ſtories above, which are merely flues. When the fire-place is finiſhed and about to be arched over, a flat iron bar of ſmall thickneſs is laid along the top of the ſide-wall on both ſides, a ſet of finiſhing bricks being moulded on purpoſe with a notch to receive the iron bar. Croſs bars are laid over theſe, one at each end and one or two between, having a bit turned down at the ends, which takes hold of the longitudinal bars, and keeps them from being thruſt outwards either by the preſſure of the arch or by the ſwelling in conſequence of the heat. In fig. 3. A is the croſs ſection of one of the long bars, and BC is part of one of the croſs bars, and CD is the clench which confines the bar A. This precaution is chiefly neceſſary, becauſe the contraction of the ſtove upwards obliges the walls of the other ſtories to bear a little on the arch of the fire-place. The building above is kept together in like manner by other courſes of iron bars at every ſecond return of the flue. The top of the ſtove is finiſhed by a pretty thick covering of brick-work. The laſt paſſage for the air at H (ſee PNEUMATICS, fig. 62.) has a ring lining its upper extremity, and projecting an inch or two above it. The flat round it is covered with ſand. When we would ſtop this paſſage, a cover ſhaped like a baſon or cover for diſhes at table is whelmed over it. The rim of this, reſting on the ſand, effectually prevents all air from coming through and getting up the vent. Acceſs is had to this damper by a door which can be ſhut tight enough to prevent the heated air of the room from waſting itſelf up the vent. When the room is too warm, it may be very rapidly cooled by opening this door. The warm air ruſhes up with great rapidity, and is replaced by cool air from without.

The management of the ſtove is as follows. About eight o'clock in the morning the *pietchnick*, or ſervant who has the charge of the ſtoves, takes off the cover, ſhuts the damper-door, and opens the fire-place door. He then puts in a handful of wood ſhavings or ſtraw, and kindles it. This warms the ſtove and vent, and begins a current of air through it. He then lays a few chips on the ſole of the fire-place, immediately within the door; and behind this he arranges the billets of birchwood, with their ends inwards. Then he lays on more wood in the front, till he thinks there is enough. He ſets fire to the chips, ſhuts the door, and opens the ſmall wicket at its bottom. The air blows the flame of the chips upon the billets behind them, and thus kindles them. They conſume ſlowly, while the billets in front remain untouched by the fire. The ſervant, having made his firſt round of the rooms, returns to this ſtove, and opens the door above to admit air into the vent. This is to ſupply its draught, and thus to check the draught in the body of the ſtove, which is generally too ſtrong at this time, and would conſume the fuel too faſt. By this time the billets in the front are burning, firſt at the bottom, and the reſt in ſucceſſion as they ſink down on the embers and come oppoſite to the wicket. The room does not yet feel any effect from the fire, the heat of which has not yet reached its external ſurface; but in about half an hour this grows warm. The upper door is ſhut again, that no heat may now be waſted. The pietchnik by and by ſpreads the embers and aſhes over the whole bottom of the fire-place with a rake, by which the bottom is greatly heated, and heats the air contiguous to it externally (for it ſtands on little pillars) very powerfully. He takes care to bring up to the top of the aſhes every bit of wood or coal that is not yet conſumed, that all may be completely expended. He does this as briſkly as poſſible, that the room may not loſe much warmed air by keeping open the fire-place door. At his laſt viſit, when he obſerves no more glowing embers, he ſhuts the fire-place door and wicket, and puts the damper on the paſſage above, and ſhuts its door.—All this is over in about an hour and a half after kindling the fire. All current of air is now at an end within the ſtove, and it is now a great maſs of brick-work, heated to a great degree within, but only about blood-warm externally. The heat gradually ſpreads outwards, and the external ſurface of the ſtove acquires its greateſt heat about three o'clock in the afternoon; after which it gradually cools till next morning.

This heat ſeldom is ſo great that one cannot bear to touch the ſtove with his cheek, and to keep it there. In conſequence of this it can burn none of the duſt which unavoidably falls on the ſtove, and we are never troubled with the ſickening ſmells that are unavoidable when we employ the ſmall caſt iron ſtoves much heated. The great expence of heat in a room ariſes from the glaſs windows. The pane is ſo thin that the external air keeps it continually cold, and thus the windows are continually robbing the air of the room of its heat. This expence of heat is reduced to leſs than one third by double caſements. The inner caſement is about as much colder than the room as the outer caſement is warmer than the air of the fields; and we have the ſingular advantage of having no ice formed on the glaſſes. But to enſure this laſt advantage, the ſeams of the inner caſement muſt be paſted with paper, and thoſe of the outer caſement muſt be left unpaſted. If we do the contrary, we ſhall certainly have ice on the outer caſement; the reaſon of which is eaſily ſeen.

We have been thus particular in our deſcription of the management, becauſe the reaſons of ſome particulars are not very obvious, and the practice would not readily occur to us in this country; ſo that a perſon who, on the

Stove. faith of our recommendation, ſhould prefer one of theſe ſtoves to the German ſtove, whoſe management is ſimple and obvious, might be greatly diſappointed. But by following this method, we are confident that the Ruſſian ſtove will be found much ſuperior both in warmth and agreeable air. The ſpreading out of the embers, and waiting till all is reduced to aſhes before the doors are ſhut, is alſo abſolutely neceſſary, and a neglect of it would expoſe us to imminent danger of ſuffocation by fixed air; and this is the only inconvenience of the Ruſſian ſtove, from which the other ſtove is free. The fixed air has no ſmell; and the firſt indication of its preſence is a ſlight giddineſs and laſſitude, which diſpoſes us to ſit down and to ſleep. This would be fatal; and we muſt immediately open the upper paſſage and the fire-place door, ſo as to produce a ſtrong current to carry the vitiated air of the room up the chimney. Throwing up the ſaſhes, or at leaſt opening all the doors, is proper on ſuch an occaſion.

If we burn pit-coal, either raw or charred, this precaution is ſtill more neceſſary; becauſe the cinder is not ſo eaſily or ſo ſoon completely conſumed. This fuel will require a little difference in the management from wood fuel, but which is eaſily ſeen by any perſon of reflection. The ſafe way would be to rake out all half-burnt coal before ſhutting up the doors.

If we uſe raw pit-coal, great care is neceſſary to prevent the accumulation of ſoot in the upper part of the ſtove. It is an inacceſſible place for the chimney ſweep; and if we attempt to burn it out, we run a great riſk of ſplitting that part of the ſtove which is the moſt ſlightly conſtructed. It is adviſable therefore to burn it away every day, by giving a briſk draught with an open door for five minutes. With wood or coak there is no danger.

It will not be improper in this place to give ſome inſtructions for the conſtruction of ſtoves for warming ſeveral floors in a great manufactory, ſuch as a cotton-mill, or a public library or muſeum.

In ſuch ſituations we think cleanlineſs, wholeſomeneſs, and ſweetneſs of air, no leſs neceſſary than in the drawing room of a man of opulence. We therefore recommend the brick-ſtove in preference to the iron one; and though it would not be the beſt or moſt economical practice to heat it but once a-day, and we ſhould rather prefer the German practice of conſtant feeding, we ſtill think it highly proper to limit the heat to a very moderate degree, and employ a large ſurface.

If the diſpoſition of the rooms allows us the conveniency of a thick party-wall, we would place the ſtove in the middle of this wall, in an arch which pierces through the wall. Immediately above this arch we would carry up a very wide chimney through the whole height. This chimney muſt have a paſſage opening into each floor on both ſides, which may be very accurately ſhut up by a door. The ſtove being ſet up under the arch, it muſt have a pipe communicating with its flue, and riſing up through this chimney. Could an earthen pipe be properly ſupported, and ſecured from ſplitting by hoops, we ſhould prefer it for the reaſons already given. But as this is perhaps expecting too much, we muſt admit the uſe of a caſt iron pipe. This is the real chimney or flue of the ſtove, and muſt be of as great diameter as poſſible, that it may act, by an extenſive ſurface, all the way up.

The ſtove ſtands under the arch in the wall; but the air that is warmed by its ſurface would eſcape on both ſides, and would be expended in that ſingle floor. To prevent this, the ſtove muſt be incloſed in a caſe: this may be of brick-work, at the diſtance of two or three inches from the ſtove all round. It muſt be well ſhut in above, and at the foundation muſt have a row of ſmall holes to admit the air all around it. This air will then be warmed over the whole ſpace between the ſtove and the caſe, paſs up the chimney, and there receive additional heat from the flue-pipe which is in the middle. Great care muſt be taken that the fire-place door have no communication with the ſpace between the ſtove and its caſe, but be incloſed in a mouth-piece which comes through the caſe, and opens into the feeding room. Thus all the air which goes up to the rooms will be pure and wholeſome, provided we take care that every thing be kept clean and ſweet about the air holes below. Obſerve that thoſe air-holes which are near the furnace door muſt be incloſed in a wooden trunk which takes in its air at ſome diſtance from this door; for ſince the current between the ſtove and caſe may be almoſt as great as the current within the ſtove (nay, when a puff of wind beats down the chimney, it may even exceed it), there is a riſk of ſome vitiated air and ſmoke being drawn into the caſe.

If the ſtove cannot be placed in the arch of a party-wall, it may be ſet adjoining to a ſide or outer wall, and furniſhed with a caſe, a large chimney, and a flue-pipe, in the ſame manner. But in this caſe a great deal of heat is waſted on this outer wall, and carried off by the external air. In this ſituation we would recommend to line that part of the wall which is behind the ſtove (at two or three inches diſtance), and the whole of the chimney, with plaſter on laths. Theſe ſhould be nailed on battens properly faſtened on the wall, leaving a ſpace of an inch between the laths and the wall. The plaſter ſhould be of the moſt ſpungy kind, having in it a quantity of clay in powder inſtead of the full proportion of ſand. Horſe-dung, waſhed with water and ſtrained through coarſe flannel, leaves a great portion of unaſſimilated vegetable fibre, which will mix very intimately in the plaſter, and make it a ſubſtance very unfit for conducting heat. There is no danger of catching fire by this lining. We have ſeen a moſt tremendous fire rage for three hours, in contact with a partition of lath and plaſter (on the plaſter-ſide however), without diſcolouring the thin laths on the other ſide. We once ſaw a cottage chimney on fire, and burn till the ſoot was conſumed. This chimney was nothing but a pipe of a foot wide, made of lathes, and plaſtered on the inſide and outſide; and it paſſed through a thatched roof. We therefore recommend this in place of the brick caſe for incloſing the ſtove. It would ſave heat; and as it might be made in pieces on detached frames, which could be joined by iron ſtraps and hinges, any part of the ſtove could be laid open for repairs at pleaſure.

We have no heſitation in ſaying that a ſtove conſtructed in this manner would be greatly ſuperior in power to any we have ſeen, and would be free from many of their diſguſting defects. We beg leave therefore to conclude this part of the ſubject by deſcribing one which was to have been erected in one of the churches of the city of Edinburgh.

Fig. 4. is a ſketch of the plan of the church contain-

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ed in the parallelogram AFED. P marks the place of the pulpit, and LMNO the front of the galleries. Theſe are carried back to the ſide-walls AB and DC. But at the end oppoſite to the pulpit they do not reach ſo far, but leave a ſpace BFEC about 12 feet wide. Below the back of the galleries, on each ſide, there is a paſſage ABGH, KICD, ſeparated from the ſeated part of the church by partitions which reach from the floor to the galleries, ſo that the ſpace HGIK is completely ſhut in. The church is an ancient Gothic building, of a light and airy ſtructure, having two rows of large windows above the arcades, and a ſpacious window in the eaſt end above the pulpit. The congregation complain of a cold air, which they feel pouring down upon their heads. This is more particularly felt by thoſe ſitting in the fronts of the galleries. We imagine that this ariſes chiefly from the extenſive ſurface of the upper row of windows, and of the cold ſtone-walls above, which robs the air of its heat as it glides up along the ſides of the church. It becomes heavier by collapſing, and in this ſtate deſcends in the middle of the church.

The ſtove S is placed againſt the middle of the weſt wall at the diſtance of a few inches, and is completely incloſed in a caſe of lath and plaſter. The vent, which is to carry off the ſmoke and burnt air, is conveyed up or along the wall, and through the roof or ſide-wall, but without any communication with the caſe. In like manner the fire-place door is open to the paſſage, without communicating with the caſe; and care is taken that the holes which admit the air into the caſe are ſo diſpoſed that they ſhall run no riſk of drawing in any air from the fire-place door.

From the top of this caſe proceed two trunks Q, R, each of which is two feet broad and ſix inches deep, coated within and without with the moſt ſpungy plaſter that can be compoſed. For this purpoſe we ſhould recommend a compoſition of powdered charcoal and as much clay and quicklime as will give it a very ſlight coheſion. We know that a piece of this may be held in the hand, without inconvenience, within an inch of where it is of a glowing red heat.—Theſe trunks open into another trunk XVTYZ, which ranges along the partition immediately under the galleries, and may be formed externally into a corniche, a little maſſive indeed, but not unſightly in a building of this ſtyle. This trunk is coated in the ſame manner. It has ſeveral openings *a*, *a*, &c. which have ſliders that can be drawn aſide by means of handles acceſſible from the outer paſſage.—At the extremities X and Z of this trunk are two perpendicular trunks which come up through the galleries, and are continued to a conſiderable height. At their junction with the horizontal trunk are two doors large enough to admit a lamp. Each perpendicular trunk has alſo a valve by which it can be completely ſtopped.

The ſtove is managed as follows: Early in the morning the ſuperintendant ſhuts all the ſliders, and ſets a lamp (burning) in each of the trunks X and Z, and ſhuts the doors. He then puts on and kindles the fire in the ſtove, and manages it either in the Ruſſian or German method. Perhaps the latter is preferable, as being liable to feweſt accidents from miſtake or neglect.

The lamps ſet in the lower ends of the upright trunks preſently warm them, and produce a current of air upwards. This muſt be ſupplied by the horizontal trunk, which muſt take it from the caſe round the ſtove. Thus a current is begun in the direction we wiſh. By and by the air in the caſe acquires heat from the ſtove, and the current becomes extremely briſk. When the manager perceives this, he removes the lamps, ſhuts the valves, and opens the holes *a*, *a*, &c. beginning with the moſt remote, and proceeding ſlowly towards the ſtove from each extremity of the horizontal branches. The heated air now iſſues by theſe holes, glides along the ceiling below the galleries, and eſcapes, by riſing up along the fronts of the galleries, and will be ſenſibly felt by thoſe ſitting there, coming on their faces with a gentle warmth. It will then riſe (in great part) ſtraight up, while ſome of it will glide backwards, to the comfort of thoſe who ſit behind.

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The propriety of ſhutting the valves of the upright trunks is evident. If they were left open, no air would come out by the holes *a*, *a*, &c.; but, on the contrary, the air would go in at theſe holes to ſupply the current, and the ſtove be rendered uſeleſs. The air delivered by theſe holes will keep cloſe to the ceiling, and will not, as we imagine, incommode thoſe who ſit below the galleries. But if it ſhould be found to render theſe parts too warm, holes may be pierced through the ceiling, by which it will riſe among the people above, and muſt be very comfortable. It will require the careful attention of ſome intelligent perſon to bring all this into a proper train at firſt, by finding the proper apertures of the different holes, ſo as to render the heat equable through the whole ſpace. But this being once aſcertained the difficulty is over.

The air trunks muſt be very capacious, but may be contracted towards the extremities as their lateral diſcharges diminiſh; and the row of holes which admit the air to the caſe round the ſtove muſt be fully able to ſupply them.

It muſt be obſerved, that in this conſtruction the aſcenſional force is but ſmall. It is only the height of a ſhort column of warm air from the ground to the galleries. At firſt indeed it is great, having the unlimited height of the perpendicular trunks at X and Z; but during the uſe of the ſtove it is reduced to nine or ten feet. It is neceſſary, therefore, that the ſtove be highly heated, perhaps conſiderably beyond the Ruſſian practice, but yet inferior to the heat of the German iron ſtoves. But ſtill we ſtrongly recommend the brick or pottery ſtoves, on account of the wholeſome ſweetneſs of the air which they furniſh; and we are certain that a ſtove of moderate dimenſions, eight feet long, for inſtance, by eight feet high, will be ſufficient for warming a church holding 1200 or 1500 people. If the ſtove could be placed lower, which in many ſituations is very practicable, its effect would be proportionally greater, becauſe all depends on the rapidity of the current. When we are limited in height, we muſt extend the ſtove ſo much the more in length, and make the air trunks more capacious. Theſe and many other circumſtances of local modification muſt be attended to by the erector of the ſtove; and without the judicious attention of an intelligent artiſt, we may expect nothing but diſappointment. It is hardly poſſible to give inſtructions ſuited to every ſituation; but a careful attention to the general principle which determines the aſcenſional force will free the artiſt from any great riſk of failure.

Stove, Stourbridge.

We may ſay the ſame thing of ſtoves for conſervatories, hot houſes, hot walls, &c. and can hardly add any thing of conſequence to what we have already ſaid on theſe heads in the article PNEUMATICS.

We muſt not, however, diſmiſs the ſubject without taking notice of the very ſpecious projects which have been frequently offered for drying malt by ſtoves. Many of theſe are to be ſeen in the publications of the Academies of Stockholm, Upſal, Copenhagen, and ſome have been erected in this kingdom; but they have not been found to anſwer.

We apprehend that they cannot anſwer. To dry malt, and make it fit for the ales and beers for which this iſland is ſo famous, it is by no means enough that we give it a proper and an equable ſupply of heat.—This alone would bake it and make it flinty, cauſing the moiſture to penetrate the mealy particles of the grain; and, by completely diſſolving the ſoluble parts, would render each kernel an uniform maſs, which would dry into a flinty grain, breaking like a piece of glaſs.—A grain of malt is not an inert pulp. It is a SEED, in an active ſtate, growing, and of an organized ſtructure. We wiſh to ſtop it in this ſtate, and kill it, not by heating it, but by abſtracting its moiſture. We thus leave it in its granulated or organized form, ſpungy, and fit for imbibing water in the maſh tub, without running into a paſte.

To accompliſh theſe purpoſes, the conſtruction of our malt kilns ſeems very well adapted. The kiln is the only flue of the furnace, and a copious *current* of air is formed through among the grains, carrying off with it the water which is evaporating by the heat. But this evaporation, being chiefly in conſequence of the vapour being immediately diſſolved by the paſſing air, will ſtop as ſoon as the current of air ſtops. This current has to make its way through moiſt grain, laid in a pretty thick bed, and matted together. Some force, therefore, is neceſſary to drive it through. This is furniſhed by the draught of the kiln. Subſtituting a ſtove, immediately applied to the malt, will not have this effect. The only way in which we think this can be done different from the preſent, is to have a horizontal flue, as has been propoſed in theſe projects, ſpread out at a ſmall diſtance below the grate on which the malt is laid, and to cover the whole with a high dome, like a glaſs houſe dome. This being filled with a tall column of hot air, and having no paſſage into it but through the malt, would produce the current which we want. We are convinced that this will make much leſs fuel ſerve; but we are by no means certain that the ſulphureous and carbonic acid which accompanies the air in our common kiln is not a neceſſary or a uſeful ingredient in the proceſs. It is well known that different coaks, cinders, or charcoals, impart different qualities to the malts, and are preferred *each for its own purpoſe*. Were this a matter of indifference, we know a method of rapidly drying malt much more economical and expeditious than by either kiln or ſtove. But this has nothing to do with our preſent ſubject, of which we now take leave.

STOURBRIDGE, or STURBICH, the name of a field near Cambridge, noted for its famous fair kept annually on the 7th of September, and which continues for a fortnight. The commodities are, horſes, hops, iron, wool, leather, cheeſe, &c. This place is alſo noted for an excellent ſpecies of clay capable of reſiſting an intenſe heat. It is uſed in making pots for glaſs-houſes, fire-bricks, &c. and is ſold at an high price.

Stow ‖ Stow-market.

STOW, the name of a market-town in Glouceſterſhire in England, ſituated in W. Long. 1. 50. N. Lat. 51. 54. It is alſo the name of a fine ſeat of the Marquis of Buckingham in Buckinghamſhire. Here are the beſt gardens in England, adorned with buſts, ſtatues, obeliſks, pavilions, and temples. It is two miles from the town of Buckingham.

STOW (John), the induſtrious hiſtorian, ſon of Thomas Stow merchant-taylor of St Michael's, Cornhill, in London, was born about the year 1525. Of the early part of his life we know very little, except that he was bred to his father's buſineſs, which in the year 1560 he relinquiſhed, devoting himſelf entirely to the ſtudy of our ancient hiſtorians, chronicles, annals, charters, regiſters, and records. Of theſe he made a conſiderable collection, travelling for that purpoſe to different parts of the kingdom, and tranſcribing ſuch manuſcripts as he could not purchaſe. But this profeſſion of an antiquary being attended with no preſent emolument, he was obliged for ſubſiſtence to return to his trade.—It happened, however, that his talents and neceſſities were made known to Dr Parker archbiſhop of Canterbury; who being himſelf an antiquary, encouraged and enabled Mr Stow to proſecute his darling ſtudy. In thoſe times of perſecution, though Elizabeth was then upon the throne, honeſt John Stow did not eſcape danger. His collection of Popiſh records was deemed cauſe of ſuſpicion. His younger brother Thomas preferred no leſs than 140 articles againſt him before the eccleſiaſtical commiſſion; but the proof being inſufficient, he was acquitted. In 1565 he firſt publiſhed his Summary of the Chronicles of England. About the year 1584 he began his Survey of London. In 1585 he was one of the two collectors for a great muſter of Limeſtreet ward: in the ſame year he petitioned the corporation of London to beſtow on him the benefit of two freemen, to enable him to publiſh his ſurvey; and in 1589 he petitioned again for a penſion. Whether he ſucceeded, is not known. He was principally concerned in the ſecond edition of Holinſhed's chronicle, publiſhed in 1587. He alſo corrected, and twice augmented, Chaucer's works, publiſhed in 1561 and in 1597. His ſurvey of London was firſt publiſhed in 1598. To theſe laborious works he would have added his large Chronicle, or Hiſtory of England; but he lived only to publiſh an abſtract of it, under the title of *Flores Hiſtoriarum*. The folio volume, which was printed after his death, with the title of *Stow's Chronicle*, was taken from his papers by Edmund Howes. Having thus ſpent his life and fortune in theſe laborious purſuits, he was at laſt obliged to ſolicit the charitable and well diſpoſed for relief. For this purpoſe, king James I. granted him, in 1603, a brief, which was renewed in 1604, authoriſing him to collect in churches the benefactions of his fellow-citizens. He died in April 1605, aged 80; and was buried in his pariſh-church of St Andrew's, Underſhaft, where his widow erected a decent monument to his memory. John Stow was a moſt indefatigable antiquarian, a faithful hiſtorian, and an honeſt man.

STOWMARKET, a town of Suffolk, in England, ſituated in E. Long. 1. 6. N. Lat. 52. 16. It is a large

Stowage ‖ Strabo.

handſome place, ſituated between the branches of the rivers Gypping and Orwell, and is remarkable for having the beſt cherries in England.

STOWAGE, the general diſpoſition of the ſeveral materials contained in a ſhip's hold, with regard to their figure, magnitude, or ſolidity.

In the ſtowage of different articles, as ballaſt, caſks, caſes, bales, and boxes, there are ſeveral general rules to be obſerved, according to the circumſtances or qualities of thoſe materials. The caſks which contain any liquid are, according to the ſea phraſe, to be *bung-up* and *bilge-free*, i. e. cloſely wedged up in an horizontal poſition, and reſting on their quarters: ſo that the bilges where they are thickeſt being entirely free all round, cannot rub againſt each other by the motion of the veſſel. Dry goods, or ſuch as may be damaged by the water, are to be carefully incloſed in caſks, bales, caſes, or wrappers; and wedged off from the bottom and ſides of the ſhip, as well as from the bow, maſts, and pump-well. Due attention muſt likewiſe be had to their diſpoſition with regard to each other, and to the trim and centre of gravity of the ſhip; ſo that the heavieſt may always be neareſt the keel, and the lighteſt gradually above them.

STRABISMUS, ſquinting. See MEDICINE-*Index*.

STRABO, a celebrated Greek geographer, philoſopher, and hiſtorian, was born at Amaſia, and was deſcended from a family ſettled at Gnoſſus in Crete. He was the diſciple of Xenarchus, a Peripatetic philoſopher, and at length attached himſelf to the Stoics. He contracted a ſtrict friendſhip with Cornelius Gallus, governor of Egypt, and travelled into ſeveral countries to obſerve the ſituation of places, and the cuſtoms of nations. He flouriſhed under Auguſtus, and died under Tiberius about the year 25, in a very advanced age.—He compoſed ſeveral works, all of which are loſt except his Geography in 17 books; which are juſtly eſteemed very precious remains of antiquity. The two firſt books are employed in ſhowing, that the ſtudy of geography is not only worthy of, but even neceſſary to, a philoſopher; the third deſcribes Spain; the fourth, Gaul and the Britannic iſles; the fifth and ſixth, Italy and the adjacent iſles; the ſeventh, which is imperfect at the end, Germany, the countries of the Getæ and Illyrii, Taurica Cherſoneſus, and Epirus; the eighth, ninth, and tenth, Greece with the neighbouring iſles; the four following, Aſia within Mount Taurus; the fifteenth and ſixteenth, Aſia without Taurus, India, Perſia, Syria, Arabia; and the ſeventeenth, Egypt, Æthiopia, Carthage, and other places of Africa. Strabo's work was publiſhed with a Latin verſion by Xylander, and notes by Iſaac Caſaubon (or rather by Henry Scrimzeer, from whom Caſaubon chiefly ſtole them), at Paris, 1620, in folio. But the beſt edition is that of Amſterdam in 1707, in two volumes folio, by the learned Theodore Janſonius ab Almelooveen, with the entire notes of Xylander, Caſaubon, Meurſius, Cluver, Holſtenius, Salmaſius, Bochart, Ez. Spanheim, Cellarius, and others. To this edition is ſubjoined the *Chreſtomathiæ*, or epitome of Strabo; which according to Mr Dodwell, who has written a very elaborate and learned diſſertation about it, was made by ſome unknown perſon between the years of Chriſt 676 and 996. It has been found of ſome uſe, not only in helping to correct the original, but in ſupplying in ſome meaſure the defect in the ſeventh book. Mr Dodwell's diſſertation is prefixed to this edition.

Strada, Strahan.

STRADA (Famianus), a very ingenious and learned Jeſuit, was born at Rome the latter end of the 16th century, and taught rhetoric there, in a public manner, for fifteen years. He wrote ſeveral pieces upon the art of oratory, and publiſhed ſome orations with a view of illuſtrating, by example what he had inculcated by precept. But his *Proluſiones Academicæ* and his *Hiſtoria de Bello Belgico* are the works which raiſed his reputation, and have preſerved his memory. His hiſtory of the war of Flanders was publiſhed at Rome; the firſt decad in 1640, the ſecond in 1647; the whole extending from the death of Charles V. which happened in 1558, to the year 1590. It is written in good Latin, as all allow; but its merit in other reſpects has been variouſly determined. His *Proluſiones Academicæ* ſhow great ingenuity, and a maſterly ſkill in claſſical literature; that proluſion eſpecially in which he introduces Lucan, Lucretius, Claudian, Ovid, Statius, and Virgil, each of them verſifying according to his own ſtrain. They have been often printed. We know not the year of Strada's birth or of his death.

STRAHAN (William), an eminent printer, was born at Edinburgh in the year 1715. His father, who had a ſmall appointment in the cuſtoms, gave his ſon the education which every one of decent rank then received in a country where the avenues to learning were eaſy, and open to men of the moſt moderate circumſtances. After having paſſed through the tuition of a grammar ſchool, he was put apprentice to a printer; and when a very young man, removed to a wider ſphere in that line of buſineſs, and went to follow his trade in London. Sober, diligent, and attentive, while his emoluments were for ſome time very ſcanty, he contrived to live rather within than beyond his income; and though he married early, and without ſuch a proviſion as prudence might have looked for in the eſtabliſhment of a family, he continued to thrive, and to better his circumſtances. This he would often mention as an encouragement to early matrimony; and uſed to ſay, that he never had a child born that Providence did not ſend ſome increaſe of income to provide for the increaſe of his houſehold. With ſufficient vigour of mind, he had that happy flow of animal ſpirits that is not eaſily diſcouraged by unpromiſing appearances.

His abilities in his profeſſion, accompanied with perfect integrity and unabating diligence, enabled him, after the firſt difficulties were overcome, to advance with rapid ſucceſs. And he was one of the moſt flouriſhing men of the trade, when, in the year 1770, he purchaſed a ſhare of the patent for king's printer of Mr Eyre, with whom he maintained the moſt cordial intimacy during the reſt of his life. Beſide the emoluments ariſing from this appointment, as well as from a very extenſive private buſineſs, he now drew largely from a field which required ſome degree of ſpeculative ſagacity to cultivate on account of the great literary property which he acquired by purchaſing the copy-rights of the moſt celebrated authors of the time. In this his liberality kept equal pace with his prudence, and in ſome caſes went perhaps rather beyond it. Never had ſuch rewards been given to the labours of literary men as now were received from him and his aſſociates in thoſe purchaſes of copy-rights from authors.

Having

Strahan.

Having now attained the firſt great object of buſineſs, wealth, Mr Strahan looked with a very allowable ambition on the ſtations of political rank and eminence. Politics had long occupied his active mind, which he had for many years purſued as his favourite amuſement, by correſponding on that ſubject with ſome of the firſt characters of the age. Mr Strahan's queries to Dr Franklin in the year 1769, reſpecting the diſcontents of the Americans, publiſhed in the London Chronicle of 28th July 1778, ſhow the juſt conception he entertained of the important conſequences of that diſpute, and his anxiety as a good ſubject to inveſtigate, at that early period, the proper means by which their grievances might be removed, and a permanent harmony reſtored between the two countries. In the year 1775 he was elected a member of parliament for the borough of Malmſbury in Wiltſhire, with a very illuſtrious colleague, the Hon. C. J Fox; and in the ſucceeding parliament, for Wootton Baſſet, in the ſame county. In this ſtation, applying himſelf with that induſtry which was natural to him, he was a uſeful member, and attended the houſe with a ſcrupulous punctuality. His talents for buſineſs acquired the conſideration to which they were intitled, and were not unnoticed by the miniſter.

In his political connections he was conſtant to the friends to whom he had firſt been attached. He was ſteady ſupporter of that party who were turned out of adminiſtration in ſpring 1784, and loſt his ſeat in the houſe of commons by the diſſolution of parliament with which that change was followed: a ſituation which he did not ſhow any deſire to reſume on the return of the new parliament; ariſing from a feeling of ſome decline in his health, which had rather ſuffered from the long ſittings and late hours with which the political warfare in the preceding had been attended. Without any fixed diſeaſe, his ſtrength viſibly declined; and though his ſpirits ſurvived his ſtrength, yet the vigour and activity of his mind were alſo conſiderably impared. Both continued gradually to decline till his death, which happened on the 9th of July 1785 in the 71ſt year of his age.

Endued with much natural ſagacity, and an attentive obſervation of life, he owed his riſe to that ſtation of opulence and reſpect which he attained, rather to his own talents and exertion, than to any accidental occurrence of favourable or fortunate circumſtances. His mind was not uninformed by letters; and from a habit of attention to ſtyle, he acquired a conſiderable portion of critical acuteneſs in the diſcernment of its beauties and defects. In one branch of writing he particularly excelled—the epiſtolary; in which he not only ſhowed the preciſion and clearneſs of buſineſs, but poſſeſſed a neatneſs as well as a fluency of expreſſion which few letter-writers have been known to ſurpaſs. Letter-writing was one of his favourite amuſements; and among his correſpondents were men of ſuch eminence and talents as well repaid his endeavours to entertain them. Among theſe, as before-mentioned, was the juſtly celebrated Dr Franklin, originally a printer like Mr Strahan, whoſe friendſhip and correſpondence, notwithſtanding the difference of their ſentiments in political matters, he continued to enjoy till his death. One of the lateſt letters which he received from his illuſtrious and venerable friend, contained a humorous allegory of the ſtate of politics in Britain, drawn from the profeſſion of printing; of which, though the Doctor had quitted the exerciſe, he had not forgotten the terms.

Strahan || Strain.

The judicious diſpoſition which Mr Strahan made of his property, affords an evident proof of his good ſenſe and propriety. After providing munificently for his widow and childern, his principal ſtudy ſeems to have been to mitigate the affliction of thoſe (and many there were) who would more immediately have felt his loſs, by bequeathing them liberal annuities for their lives; and (recollecting that all of a profeſſion are not equally provident) he left 1000 l. to the Company of Stationers, the intereſt to be divided among infirm old printers.

As the virtuous connections of the life and the heart are always pleaſing to trace—of Mr Strahan it may briefly be ſaid, that his capacity, diligence, and probity, raiſed him to the head of his profeſſion. The good humour and obliging diſpoſition which he owed to nature, he cultivated with care, and confirmed by habit. His ſympathetic heart beat time to the joy and ſorrow of his friends. His advice was always ready to direct youth, and his purſe open to relieve indigence. Living in times not the pureſt in the Engliſh annals, he eſcaped unſullied through the artifices of trade and the corruption of politics. In him a ſtrong natural ſagacity, improved by an extenſive knowledge of the world, ſerved only to render reſpectable his unaffected ſimplicity of manners, and to make his Chriſtian philanthropy more diſcerning and uſeful. The uninterrupted health and happineſs which accompained him for half a century in the capital, proves honeſty to be the beſt policy, temperance the greateſt luxury, and the eſſential duties of life its moſt agreeable amuſement. In his elevated fortune, none of his former acquaintance ever accuſed him of neglect. He attained proſperity without envy, enjoyed wealth without pride, and diſpenſed bounty without oſtentation.

STRAIKS, in the military art, are ſtrong plates of iron, ſix in number, fixed with large nails called *ſtraik-nails*, on the circumference of a cannon-wheel, over the joints of the fellows; both to ſtrengthen the wheel, and to ſave the fellows from wearing on hard ways or ſtreets.

STRAIN, a pain occaſioned by the violent extenſion of ſome membranous or tendinous part.

Strain, *Streſs*, in mechanics, are terms indiſcriminately uſed to expreſs the force which is *excited* in any part of a machine or ſtructure of any kind tending to break it in that part. Thus every part of a rope is *equally* ſtrained by the weight which it ſuſpends. Every part of a pillar is *equally* ſtrained by the load which it ſupports. A mill axle is *equally* twiſted and ſtrained in every part which lies between the part of the wheel actuated by the moving power and the part which is reſiſted by the work to be performed. Every part of a lever or joiſt is *differently* ſtrained by a force acting on a diſtant part.

It is evident that we cannot make the ſtructure fit for its purpoſe, unleſs the ſtrength in every part be at leaſt equal to the ſtreſs laid on, or the ſtrain excited in that part. It is no leſs plain, that if we are ignorant of the principles which determine this ſtrain, both in intenſity and direction, in relation to the magnitude and the ſituation of its remote cauſe, the only ſecurity we have for ſucceſs is to give to every part of the aſſemblage

Strain ‖ Strait.

blage ſuch ſolidity that we can leave no doubt of its ſufficiency. But daily experience ſhows us that this vague ſecurity is in many caſes uncertain, if we are thus ignorant. In all caſes it is ſlovenly, unlike an artiſt, attended with uſeleſs expence, and in machines is attended with a loſs of power which is waſted in changing the motions of a needleſs load of matter.

It muſt therefore greatly tend to the improvement of all profeſſions occupied in the erection or employment of ſuch ſtructures to have a diſtinct notion of the ſtrains to which their parts are expoſed. Frequently, nay generally, theſe ſtrains are not immediate, but ariſe from the action of forces on diſtant parts, by which the aſſemblage is ſtrained, and there is a tendency to rupture in every part. This ſtrain is *induced* on every part, and is there modified by fixed mechanical laws. Theſe it is our buſineſs to learn; but our chief object in this inveſtigation is to determine the ſtrength of materials which it is neceſſary to oppoſe in every part to this ſtrain; and how to oppoſe this ſtrength in ſuch a manner that it ſhall be exerted to the beſt advantage. The notions of ſtrain and ſtrength therefore hardly admit of ſeparation; for it is even by means of the ſtrength of the intermediate parts that the ſtrain is propagated to, or excited in, the part under conſideration. It is proper therefore to conſider the whole together under the article *Strength of Materials* in mechanics.

STRAINING, is the clarification of a liquor, by paſſing it through a ſieve or filter. The word is derived from the French, *eſtreindre*; which is formed from *ex*, "out of," and *ſtringere*, "to preſs."

STRAIT, a narrow channel or arm of the ſea, ſhut up between lands on either ſide, and affording a paſſage out of one great ſea into another.

There are three kinds of ſtraits. 1. Such as join one ocean to another. Of this kind are the ſtraits of Magellan and Le Maire. 2. Thoſe which join the ocean to a gulf: the ſtraits of Gibraltar and Babelmandel are of this kind, the Mediterranean and Red Sea being only large gulfs. 3. Thoſe which join one gulf to another; as the ſtraits of Caffa, which join the Palus Mæotis to the Euxine or Black Sea. The paſſage of ſtraits is commonly dangerous, on account of the rapidity and oppoſite motion of currents. The moſt celebrated ſtrait in the world is that of Gibraltar, which is about from 24 to 36 miles long, and from 15 to 24 broad, joining the Mediterranean ſea with the Atlantic ocean. The ſtraits of Magellan, diſcovered in 1520 by F. Magellan, were uſed ſome time as a paſſage out of the North into the South Sea; but ſince the year 1616, that the ſtrait of Le Maire has been diſcovered, the former has been diſuſed; both becauſe of its length, which is full three hundred miles, and becauſe the navigation thereof is very dangerous, from the waves of the North and South Seas meeting in it and claſhing. The ſtrait at the entrance of the Baltic is called the *Sound*. That between England and France, *Le pas de Calais*, or the *Channel*. There are alſo the ſtraits of Weigats, of Jeſſo, of Anian, of Davis, and Hudſon, &c.

STRAKES, or STREAKS, in a ſhip, the uniform ranges of planks on the bottom and ſides of a ſhip, or the continuation of planks joined to the ends of each other, and reaching from the ſtem to the ſtern-poſt and faſhion-pieces; the loweſt of theſe, which is called the *garboard-ſtreak*, is let into the keel below, and into the ſtem and ſtern-poſt. They ſay alſo a ſhip *heels a ſtrake*, that is, hangs or inclines to one ſide the quantity of a whole plank's breadth.

Strakes ‖ Strange.

STRAKES, or *ſtreks*, in mining, are frames of boards fixed on or in the ground, where they waſh and dreſs the ſmall ore in a little ſtream of water, hence called *ſtraked ore*.

STRALSUND, a ſtrong and rich ſea-port town of Germany, in Hither Pomerania, and was formerly an important trading-place. In 1678 it was forced to ſurrender to the elector of Brandenburg, after 1800 houſes had been burnt to aſhes in one night's time. After this the Swedes defended it to the laſt extremity; and Charles XII. in 1714, came hither after its return out of Turkey. But the crown of Sweden not being able to hold out againſt five great powers, it was forced to ſubmit in 1715. In 1720 it was rendered back to Sweden, but in a very poor condition. It is almoſt ſurrounded by the ſea and the lake Francen, and has a harbour ſeparated from the iſle of Rugen by a narrow ſtrait. It is 15 miles north-weſt of Grippſwald, and 40 north-eaſt of Guſtrow. E. Long. 13. 28. N. Lat. 54. 17.

STRAMONIUM, in botany; a ſpecies of DATURA.

STRAND (*Saxon*), any ſhore or bank of a ſea or great river. Hence the ſtreet in the weſt ſuburbs of London, which lay next the ſhore or bank of the Thames, was called the *Strand*. An immunity from cuſtom, and all impoſitions upon goods or veſſels by land or water, was uſually expreſſed by *ſtrand* or *ſtream*.

STRANDED (from the Saxon *ſtrand*), is when a ſhip is by tempeſt, or by ill ſteerage, run on ground, and ſo periſhes. Where a veſſel is ſtranded, juſtices of the peace, &c. ſhall command conſtables near the ſea-coaſts to call aſſiſtance for the preſervation of the ſhip; and officers of men of war are to be aiding and aſſiſting thereto.

STRANGE (Sir Robert), who carried the art of engraving to ſo great perfection in this country, was a man of ſuch general merit, that a life of him, not merely eſtimating his character as an artiſt, but alſo pourtraying his private virtues and domeſtic habits, would be both uſeful and entertaining. Such a life, we have reaſon to believe, will be preſented to the public. Modeſt as he was ingenious, he uſed indeed to ſay that the works of an artiſt ſhould ſerve for a life and monument to him. His works no doubt will perpetuate his name whilſt any taſte for the fine arts remains. In the mean time, we cannot but here give a ſhort ſketch of his hiſtory, the accuracy of which may be depended on.

Sir Robert Strange was born in the iſland of Pomona in Orkney, July the 14th 1721; and died at London July the 5th 1792. He was lineally deſcended from David Strange or Strang, a younger ſon of the family of the Stranges or Strangs (A) of Balcaſky, in the county

(A) The name of *Strange* or *Strang* is indiſcriminately uſed in the old charters and deeds of the Balcaſky family, now in the poſſeſſion of Sir Robert Anſtruther of Balcaſky, baronet.

Strange. ty of Fife, who ſettled in Orkney at the time of the Reformation. But as there were no males remaining of the elder branch of the Stranges of Balcaſky, Sir Robert became the male repreſentative of it, and was found by a legal inveſtigation to have a right to the armorial bearings and every other mark of honour belonging to that ancient family.

He received his claſſical education at Kirkwall in Orkney under the care of a learned, worthy, and much reſpected gentleman, Mr Murdoch Mackenzie, ſtill alive (1795), who has rendered infinite ſervice to his country by the accurate ſurveys and charts he has given of the iſlands of Orkney and of the Britiſh and Iriſh coaſts.

Originally intended for the law, Mr Strange ſoon became tired of that profeſſion, and perceived that his genius deciſively led him to the arts of drawing and engraving. For this purpoſe he was introduced to the late Mr Richard Cooper at Edinburgh, the only perſon there who had then any taſte in that line of the fine arts. He was bound with him as an apprentice for ſix years; during which time he made ſuch progreſs in his new profeſſion, that his friends entertained the higheſt expectation of his ſucceſs; nor were they diſappointed.

In the year 1747 he married Iſabella, only daughter of William Lumiſden, ſon of Biſhop Lumiſden; and ſoon after his marriage he went to France, where with the moſt ardent application he proſecuted his ſtudies, chiefly at Paris, under the direction of the celebrated Le Bas, who engraved many excellent prints from the Dutch painters. It was from Le Bas he had the firſt hint of the uſe of the inſtrument commonly called *the dry needle*; but which he afterwards greatly improved by his own genius, and which has added ſuch ſuperior beauties to his engravings.

In the year 1751 Mr Strange removed with his family from Edinburgh and ſettled at London, where he engraved ſeveral fine hiſtorical prints, which juſtly acquired to him great reputation. At this period hiſtorical engraving had made little progreſs in Britain, and he may be properly conſidered as its father.

The admiration he always had for the works of the great Italian painters made him long deſire to viſit Italy, the ſeat of the fine arts; and the farther he advanced in life, he became the more perſuaded that a journey to that country was eſſential to an artiſt who had the laudable ambition to excel in his profeſſion. He therefore undertook this journey in the year 1760. In Italy he made many admirable drawings, ſeveral of which he afterwards engraved. Theſe drawings are now in the poſſeſſion of Lord Dundas.

Everywhere in Italy ſingular marks of attention were beſtowed on Mr Strange; not only by great perſonages, but by the principal academies of the fine arts in that country. He was made a member of the academies of Rome, Florence, and Bologna, and profeſſor in the royal academy at Parma.

To ſhow the eſtimation in which his talents were held at Rome, we cannot but record the following anecdote. The ceiling of the room of the Vatican library, in which the collection of engravings are kept, is elegantly painted by Signor Rotſanelli. It repreſents the progreſs of engraving; and the portraits of the moſt eminent artiſts in that line are there introduced, among which is that of our artiſt. Under his arm he holds a portfolio, on which his name is inſcribed. He is the only Britiſh artiſt on whom this honour has been conferred. Strange.

In France, where he reſided many years at different periods, his talents likewiſe received every mark of attention that could be beſtowed on a foreigner. He was made a member of the royal academy of painting at Paris.

His majeſty King George III. ever attentive to the progreſs of the fine arts in Britain, and ſenſible of the advantages of which engraving particularly has been to this country, even in a commercial light; and deſirous to give a mark of his royal approbation of the merit of Mr Strange, whom he conſidered as at the head of his profeſſion and the great improver of it—was graciouſly pleaſed to confer the honour of knighthood on him the 5th of January 1787.

Such was Sir Robert Strange as an artiſt; nor was he leſs diſtinguiſhed by his truly amiable moral qualities, which endeared him to all who had the happineſs to know him.

With regard to his works, he left fifty capital plates, ſtill in good condition, which are carefully preſerved in his family. They are engraved from pictures by the moſt celebrated painters of the Roman, Florentine, Lombard, Venetian, and other ſchools. They are hiſtorical, both ſacred and profane, poetical, allegorical.

From his earlieſt eſtabliſhment in life, Sir Robert carefully preſerved about eighty copies of the fineſt and moſt choice impreſſions of each plate he engraved; which, from length of time, have acquired a beauty, mellowneſs, and brilliancy, eaſier ſeen than deſcribed. He did this with a view of preſenting them to the public at a period when age ſhould diſable him from adding to their number. Theſe he collected into as many volumes, and arranged them in the order in which they were engraved. To each volume he prefixed two portraits of himſelf, on the ſame plate, the one an etching, the other a finiſhed proof, from a drawing by John Baptiſte Greuſe. This is the laſt plate he engraved; and which is a proof that neither his eyes nor hand were impaired by age. It likewiſe ſhows the uſe he made both of aquafortis and the graver. Each volume, beſides a dedication to the king, contains an introduction on the progreſs of engraving, and critical remarks on the pictures from which his engravings are taken. Theſe volumes were ready to be given to the public, when Sir Robert's death and conſequent circumſtances delayed this magnificent publication; a publication which does ſo much honour to the artiſt, and to the country which gave him birth (B)

STRANGER.

(B) Solicitous to make all our biographical articles the vehicles of truth, and particularly deſirous to do juſtice to the memory of our illuſtrious countryman Sir Robert Strange, we applied for information reſpecting him to the perſon whom we conſidered as the moſt capable of furniſhing it, and to whom we imagined that our application would be in a high degree grateful. With ſome difficulty we obtained, as a favour to ourſelves, the ſketch of

Stranger ‖ Straſburg

STRANGER, in law, denotes a perſon who is not privy or party to an act. Thus a ſtranger to a judgement is he to whom a judgment does not belong; in which ſenſe the word ſtands directly oppoſed to party or privy.

STRANGLES, in FARRIERY. See that article, § xiv.

STRANGURY, a ſuppreſſion of urine. See MEDICINE, n° 119

STRAP, among ſurgeons, a ſort of band uſed to ſtretch out limbs in the ſetting of broken or disjointed bones.

STRAP, in a ſhip, the rope which is ſpliced about any block, and made with an eye to faſten it anywhere on occaſion.

STRAPS, in the manege. The ſtraps of a ſaddle are ſmall leather ſtraps, nailed to the bows of the ſaddle, with which we make the girths faſt to the ſaddle.

STRAPADO, or STRAPPADO, a kind of military puniſhment, wherein the criminals hands being tied behind him, he is hoiſted up with a rope to the top of a long piece of wood, and let fall again almoſt to the ground; ſo that, by the weight of his body in the ſhock, his arms are diſlocated. Sometimes he is to undergo three ſtrapadoes or more.

STRASBURG, an ancient, large, handſome, populous, and ſtrong city of France in Alſace. It contains about 200 ſtreets, part of which are very narrow, and moſt of the houſes are built after the ancient taſte. However, there are a great number of handſome buildings, ſuch as the hotel of the marſhal of France, who is commander of the city; the hotel of the cardinal of Rouen, the biſhops palace, the Jeſuits college, the royal hoſpital, the hotel of Heſſe-Darmſtadt, the arſenal, the town-houſe, and the cathedral. It has a wooden bridge over the Rhine, which is thought to be one of the fineſt in Europe; as is likewiſe the cathedral church, whoſe tower is the handſomeſt in Germany, and the clock is greatly admired by all travellers. Some look upon it as one of the wonders of the world, and the ſteeple is allowed to be the higheſt in Europe. The clock not only ſhows the hours of the day, but the motion of the ſun, moon, and ſtars. Among other things there is an angel, which turns an hour-glaſs every hour; and the twelve apoſtles proclaim noon, by each of them ſtriking a blow with a hammer on a bell. There is likewiſe a cock, which is a piece of clock-work, that crows every hour. There are 700 ſteps up to the tower or ſteeple, it being 500 feet high. It was a free and imperial city; but the king of France became maſter of it in 1681, and greatly augmented the fortifications, though before it had as many cannon as there are days in the year. The inhabitants were formerly Proteſtants, and carried on a great trade; but moſt of them have been obliged to embrace the Romiſh ſuperſtition, though there is ſtill a ſort of toleration. Such was Straſburg before the French revolution; what it is now we have not leiſure to inquire. It is ſeated on the river Ill, 55 miles north of Baſil, 112 ſouth-weſt of Mentz, and 255 eaſt of Paris. E. Long. 7. 51. N. Lat. 48. 35. Straſburg, Strata.

STRATA, in natural hiſtory, the ſeveral beds or layers of different matters whereof the earth is compoſed. See QUARRY.

The ſtrata whereof the earth is compoſed are ſo very different in different countries, that it is impoſſible to ſay any thing concerning them that may be generally applicable: and indeed the depths to which we can penetrate are ſo ſmall, that only a very few can be known to

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of his life, which we have laid before our readers, upon the expreſs condition that we ſhould not alter a *ſingle word of it*; as the compoſition, we were told, would do *honour to our work*. We have obſerved the condition, and therefore cannot claim this honour to any of the uſual writers in the Encyclopædia Britannica. If Sir Robert's more intimate friends ſhall be pleaſed with the article, their gratitude will be due not to us, but to ſome of his neareſt relations; and what may appear its defects to others (for the taſtes of mankind are very different), we truſt will be ſupplied by the following authentic catalogue of his works: Plate 1. Two Heads of the author—one an etching, the other a finiſhed proof, from a drawing by John Baptiſte Greuſe; 2. The Return from Market, by Wouvermans; 3. Cupid, by Vanloo; 4. Mary Magdalen, by Guido; 5. Cleopatra, by the ſame; 6. The Madonna, by the ſame; 7. The Angel Gabriel, by the ſame; 8. The Virgin, holding in her hand a book, and attended by angels, by Carlo Maratt; 9. The Virgin with the Child aſleep, by the ſame; 10. Liberality and Modeſty, by Guido; 11. Apollo rewarding Merit and puniſhing Arrogance, by Andrea Sacchi; 12. The Finding of Romulus and Remus, by Pietro da Cortona; 13. Cæſar repudiating Pompeia, by the ſame; 14. Three Children of King Charles I. by Vandyke; 15. Beliſarius, by Salvator Roſa; 16. St Agnes, by Dominichino; 17. The Judgment of Hercules, by Nicolas Pouſſin; 18. Venus attired by the Graces, by Guido; 19 and 20. Juſtice and Meekneſs, by Raphael; 21. The Offspring of Love, by Guido; 22. Cupid ſleeping, by the ſame; 23. Abraham giving up the Handmaid Hagar, by Guercino; 24. Eſther a Suppliant before Ahaſuerus, by the ſame; 25. Joſeph and Potiphar's Wife, by Guido; 26. Venus Blinding Cupid, by Titian; 27. Venus, by the ſame; 28. Danae, by the ſame; 29. Portrait of King Charles I. by Vandyke; 30. The Madonna, by Correggio; 31. St Cæcilia, by Raphael; 32. Mary Magdalen, by Guido; 33. Our Saviour appearing to his Mother after his Reſurrection, by Guercino; 34. A Mother and Child, by Parmegiano; 35. Cupid Meditating, by Schidoni; 36. Laomedon King of Troy detected by Neptune and Apollo, by Salvator Roſa; 37. The Death of Dido, by Guercino; 38. Venus and Adonis, by Titian; 39. Fortune, by Guido; 40. Cleopatra, by the ſame; 41. Two Children at School, by Schidoni; 42. Mary Magdalen, by Correggio; 43. Portrait of King Charles I. attended by the Marquis of Hamilton, by Vandyke; 44. Queen Henrietta, attended by the Prince of Wales, and holding in her Arms the Duke of York, by the ſame; 45. Apotheoſis of the Royal Children, by Weſt; 46. The Annunciation, by Guido; 47. Portrait of Raphael Sancio D'Urbino, by himſelf; 48. Sappho, by Carlo Dolci; 49. Our Saviour aſleep, by Vandyke; 50. St John in the Deſert, by Murillo.

Strata.

to us at any rate; thoſe that lie near the centre, or even a great way from it, being for ever hid. One reaſon why we cannot penetrate to any great depth is, that as we go down the air becomes foul, loaded with pernicious vapours, inflammable air, fixed air, &c. which deſtroy the miners, and there is no poſſibility of going on. In many places, however, theſe vapours become pernicious much ſooner than in others, particularly where ſulphureous minerals abound, as in mines of metal, coal, &c.

But however great differences there may be among the under ſtrata, the upper one is in ſome reſpects the ſame all over the globe, at leaſt in this reſpect, that it is fit for the ſupport of vegetables, which the others are not, without long expoſure to the air. Properly ſpeaking, indeed, the upper ſtratum of the earth all round, is compoſed of the pure vegetable mold, though in many places it is mixed with large quantities of other ſtrata, as clay, ſand, gravel, &c.; and hence proceed the differences of ſoils ſo well known to thoſe who practiſe agriculture.

It has been ſuppoſed, by ſome naturaliſts, that the different ſtrata of which the earth is compoſed were originally formed at the creation, and have continued in a manner immutable ever ſince: but this cannot poſſibly have been the caſe, ſince we find that many of the ſtrata are ſtrangely intermixed with each other; the bones of animals both marine and terreſtrial are frequently found at great depths in the earth; beds of oyſter-ſhells are found of immenſe extent in ſeveral countries; and concerning theſe and other ſhell-fiſh, it is remarkable, that they are generally found much farther from the ſurface than the bones or teeth either of marine or terreſtrial animals. Neither are the ſhells or other remains of fiſh found in thoſe countries adjoining to the ſeas where they grow naturally, but in the moſt diſtant regions. Mr Whitehurſt, in his Inquiry into the Original State and Formation of the Earth, has given the following account of many different kinds of animals, whoſe ſhells and other remains or *exuviæ* are found in England; though at preſent the living animals are not to be found except in the Eaſt and Weſt Indies.

A Catalogue *of* Extraneous Fossils, *ſhowing where they were dug up; alſo their native Climates. Moſtly ſelected from the curious Cabinet of Mr* Neilson, *in* King-ſtreet, Red-Lion Square.

Their names, and Places where found.	Native Climates.
Chambered Nautilus. Sheppy Iſlands; Richmond in Surrey; Sherbone in Dorſetſhire, -	*Chineſe Ocean, and other Parts of that great ſea.*
Teeth of Sharks. Sheppy Iſland, Oxfordſhire, Middleſex, Surrey, Northamptonſhire, -	*Eaſt and Weſt Indies.*
Sea-Tortoise, ſeveral kinds; the *Hawkſbill, Loggerhead, and Green* ſpecies. Sheppy Iſland, -	*Weſt Indies.*
Mangrove Tree Oysters. Sheppy Iſland, - -	*Weſt Indies.*
Coxcomb Tree Oysters. Oxfordſhire, Glouceſterſhire, Dorſetſhire, and Hanover, -	*Coaſt of Guinea.*
Vertebræ *and* Palates *of the* Orbes. Sheppy Iſlands, and many other parts of England, -	*Eaſt and Weſt Indies.*
Crocodile. Germany, Derbyſhire, Nottinghamſhire, Oxfordſhire, and Yorkſhire, -	
Alligator's Teeth. Oxfordſhire, Sheppy Iſland, -	*Eaſt and Weſt Indies.*
The Banded Buccinum. Oxfordſhire, and the Alps, -	*Weſt Indies.*
The Dipping-Snail, and Star-Fish. Sheppy Iſland. -	*Weſt Indies.*
Tail Buccinum. Sheppy Iſland, Hordel Cliff, Hampſhire, -	*Eaſt Indies.*

Nothing has more perplexed thoſe who undertake to form theories of the earth than theſe appearances. Some have at once boldly aſſerted, from theſe and other phenomena, that the world is eternal. Others have had recourſe to the univerſal deluge. Some, among whom is the Count de Buffon, endeavour to prove that the ocean and dry land are perpetually changing places; that for many ages the higheſt mountains have been covered with water, in conſequence of which the marine animals juſt mentioned were generated in ſuch vaſt quantities, that the waters will again cover theſe mountains, the habitable part of the earth become ſea, and the ſea become dry land as before, &c. Others have imagined that they might be occaſioned by volcanoes, earthquakes, &c. which confound the different ſtrata, and often intermix the productions of the ſea with thoſe of the dry land.

Theſe ſubjects have been diſcuſſed under the article Earth, to which therefore we refer the reader; and ſhall conclude with ſome account of the ſtrata in thoſe places where they have been moſt particularly obſerved.

Under the article Natural History, Sect. I. it is obſerved, that the upper ſtrata of the earth and mountains generally conſiſt of rag-ſtone, the next of ſlate, the third of marble filled with petrifactions, the fourth again of ſlate, and the next of free ſtone. But we are far from conſidering this as a rule which holds univerſally. The ſtrata differ exceedingly in a great number of places; ſome inſtances of which we ſhall give from Mr Whitehurſt.—At Alfreton Common in Derbyſhire, the ſtrata are,

A Table *of the* Strata *at* Alfreton Common. *Inquiry into the Original State and Formation of the Earth*, p. 211.

Numb.		Feet.	Inch.
1	Clay - -	7	0
2	Ratchell, *fragments of ſtone* -	9	0
3	Bind *indurated clay* - -	13	4
4	Stone, *argillaceous concreted clay*	6	0
5	Bind - - -	8	8
6	Bind - - -	25	0
7	Stone, *a black colour* -	5	0
8	Bind - - -	2	0
9	Stone - - -	2	0
10	Bind - - -	5	0
11	Bind - - -	5	0
12	Coal - - -	1	6
13	Bind - - -	1	6
14	Stone - - -	23	0
15	Stone - -	14	0
16	Bind - - -	7	0
17	Smutt, *a black ſubſtance, reſembling a ſtratum of coal-duſt* -	3	0
	Carried over	138	0

Strata.	Numb.		Feet.	Inch.
		Brought over -	138	0
	18	Bind - - -	3	0
	19	Stone - - -	20	0
	20	Bind - - -	16	0
	21	Coal - - -	7	4
			184	4

A Table of the Strata at West Hallam.

Numb.		Feet.	Inch.
1	Clay - - -	7	6
2	Bind - - -	48	0
3	Smutt - - -	1	6
4	Clunch, *or indurated clay* -	4	0
5	Bind - -	3	0
6	Stone - - -	2	3
7	Bind - - -	1	0
8	Stone - - -	1	0
9	Bind - - -	3	0
10	Stone - - -	1	0
11	Bind - - -	16	0
12	Shale - - -	2	0
13	Bind - - -	12	0
14	Shale - - -	3	0
15	Clunch, *ſtone and ſometimes cank* -	54	0
16	Soft Coal - - -	4	0
17	Clay - - -	0	6
18	Soft Coal - - -	4	6
19	Clunch *and* Bind - -	21	0
20	Coal - -	1	0
21	Bind - -	1	0
22	*Strong, broad* Bind -	25	0
23	Coal - - -	6	0
		222	3

Mr Forſter has given an account of ſome of the ſtrata of the South-Sea iſlands, the ſubſtance of which may be ſeen in the following table.

South Georgia.

1. No ſoil, except in a few crevices of the rocks.
2. Ponderous ſlate, with ſome irony particles, in horizontal ſtrata, perpendicularly interſected with veins of quartz.

Southern Iſle of New Zealand.

1. Fine light black mould, in ſome places nine inches deep, but generally not ſo much.
2. An argillaceous ſubſtance, nearly related to the claſs of Talcons, turned into earth by the action of the air.
3. The ſame ſubſtance farther indurated, in oblique ſtrata, generally dipping to the ſouth.

Easter Island.

1. Reddiſh-brown duſty mould, looking as if it had been burnt.
2. Burnt rocks, reſembling ſlags or droſs and other volcanic matters.

Marquesas.

1. Clay mixed with mould.
2. An earthy argillaceous ſubſtance mixed with tarras and puzzolana.

Otaheite.

The ſhores are coral rock, extending from the reef encircling theſe iſles to the very high water-mark. There begins the ſand, formed in ſome places from ſmall ſhells and rubbed pieces of coral; but in others the ſhores are covered with blackiſh ſand, conſiſting of the former ſort mixed with black, ſometimes glittering, particles of mica, and here and there ſome particles of the refractory iron ores called in England Skim, the *ferrum micaceum* of Linnæus, and Kall the *molybdænum ſpuma lupi* of the ſame author. The plains from the ſhores to the foot of the hills are covered with a very fine thick ſtratum of black mould, mixed with the above-mentioned ſand, which the natives manure with ſhells. The firſt and lower range of hills are formed of a red ochreous earth, ſometimes ſo intenſely red, that the natives uſe it to paint their canoes and cloth. The higher hills conſiſt of a hard, compact, and ſtiff clayey ſubſtance, hardening into ſtone when out of the reach of the ſun and air. At the top of the valleys, along the banks of the rivers, are large maſſes of coarſe granite ſtones of various mixtures; in one place are pillars of a grey, ſolid baſaltes; and, in ſeveral others, fragments of black baſaltes.

Friendly Islands and New Hebrides.

The ſame with the above.

Mallicollo.

Yellowiſh clay mixed with common ſand.

Tanna, *a Volcanic Iſland.*

The chief ſtrata here are clay mixed with aluminous earth, interſperſed with lumps of pure chalk. The ſtrata of the clay are about ſix inches, deviating very little from the horizontal line.

New Caledonia and the *adjacent Iſles.*

The ſhores conſiſt of ſhell-ſand, and particles of quartz; the ſoil in the plains a black mould mixed with this ſand. The ſides of the hills compoſed of a yellow ochreous clay, richly ſpangled with ſmall particles of cat-ſilver, or a whitiſh kind of daze, the *mica argentea* of Linnæus. The higher parts of the hills conſiſt of a ſtone called by the German miners *geſtelſtein*, compoſed of quartz and great lumps of the above cat-ſilver. The latter is ſometimes of an intenſely red or orange colour, by means of an iron ochre.

"From the above account, "ſays Mr Forſter," it appears, I think, evidently, that all the high tropical iſles of the South Sea have been ſubject to the action of volcanoes. Pyritical and ſulphureous ſubſtances, together with a few iron-ſtones, and ſome veſtiges of copper, are no doubt found in ſeveral of them: but the mountains of New Caledonia are the moſt likely to contain the richeſt metallic veins; and the ſame opinion, I ſuſpect, may be formed of the mountains in New Zealand."

In the city of Modena in Italy, and for ſome miles round that place, there is the moſt ſingular arrangement of ſtrata perhaps in the whole world. From the ſurface of the ground to the depth of 14 feet, they meet with nothing but the ruins of an ancient city. Being come to that depth, they find paved ſtreets, artificers ſhops, floors of houſes, and ſeveral pieces of inlaid work. After theſe ruins they find a very ſolid earth, which one would think had never been removed; but a little lower they find it black and marſhy, and full of briars. Signior Ramazzini in one place found a heap of wheat entire at the depth of 24 feet; in another, he found filbert-

Strata ‖ Strategus.

filbert-trees with their nuts. At the depth of about 28 feet, they find a bed of chalk, about 11 feet deep, which cuts very eaſily; after this a bed of marſhy earth of about two feet, mixed with ruſhes, leaves, and branches. After this bed comes another of chalk, nearly of the ſame thickneſs; and which ends at the depth of 42 feet. This is followed by another bed of marſhy earth like the former; after which comes a new chalk-bed, but thinner, which alſo has a marſhy bed underneath it. This ends at the depth of 63 feet; after which they find ſand mingled with ſmall gravel, and ſeveral marine ſhells. This ſtratum is uſually about five feet deep, and underneath it is a vaſt reſervoir of water. It is on account of this water that the ſoil is ſo frequently dug, and the ſtrata ſo well known in this part of the world. After coming to the ſandy bottom above-mentioned, the workmen pierce the ground with a terebra or auger, when the water immediately ſprings up with great force, and fills the well to the brim. The flow is perpetual, and neither increaſes by rain, nor decreaſes by drought. Sometimes the auger meets with great trees, which give the workmen much trouble; they alſo ſometimes ſee at the bottom of theſe wells great bones, coals, flints, and pieces of iron.

It has been aſſerted by ſome, that the ſpecific gravity of the ſtrata conſtantly increaſed with the depth from the ſurface. But Dr Leigh, in his Natural Hiſtory of Lancaſhire, ſpeaking of the coal-pits, denies the ſtrata to lie according to the laws of gravitation; obſerving, that the ſtrata there are firſt a bed of marle, then free-ſtone, next iron-ſtone, then coal, or channel mire, then ſome other ſtrata, then coal again, &c. This determined Mr Derham to make a nicer inquiry into the matter: accordingly, in 1712, he cauſed divers places to be bored, laying the ſeveral ſtrata by themſelves; and afterwards determined very carefully their ſpecific gravity. The reſult was, that in his yard the ſtrata were gradually ſpecifically heavier and heavier the lower and lower they went; but in another place in his fields, he could not perceive any difference in the ſpecific gravities.

Acquainting the Royal Society therewith, their operator Mr Haukſbee was ordered to try the ſtrata of a coal pit, which he did to the depth of 30 ſtrata: the thickneſs and ſpecific gravity of each whereof he gives us in a table in the Philoſophical Tranſactions; and from the whole makes this inference, that it evidently appears the gravities of the ſeveral ſtrata are in no manner of order, but purely caſual, as if mixed by chance.

Vol. xxvi. p. 541.

STRATAGEM, in the art of war, any device for deceiving and ſurpriſing an enemy. The ancients dealt very much in ſtratagems; the moderns wage war more openly, and on the ſquare. Frontinus has made a collection of the ancient ſtratagems of war.

STRATEGUS, στρατηγος, in antiquity, an officer among the Athenians, whereof there were two choſen yearly, to command the troops of the ſtate.

Plutarch ſays, there was one choſen from out of each tribe; but Pollux ſeems to ſay they were choſen indifferently out of the people. The people themſelves made the choice; and that on the laſt day of the year, in a place called *Pnyx*. The two *ſtrategi* did not command together, but took their turns day by day; as we find from Herodotus and Cornelius Nepos. Sometimes indeed, as when a perſon was found of merit vaſtly ſuperior, and exceedingly famed in war, the command was given to him alone: but it was ever a rule, not to put any perſon in the office but whoſe eſtate was in Attica, and who had children, that there might be ſome hoſtages and ſecurities for his conduct and fidelity. Conſtantine the Great, beſides many other privileges granted to the city of Athens, honoured its chief magiſtrate with the title of Μεγας Στρατηλος, *Magnus Dux*.

Strath ‖ Strawberry.

STRATH, in the Scottiſh language, ſignifies a long narrow valley, with a river running along the bottom.

STRATHEARN, a beautiful and extenſive valley in Perthſhire, bounded on the north by the lofty ridge of mountains called the *Grampians*, and on the ſouth by the Ochils, which are rounded on the tops and covered with verdure. It is called *Strathearn* from the river Earn, which runs through the middle of it from weſt to eaſt for about 30 miles. On each ſide of the banks of this beautiful ſtream are many villages and country-ſeats diſtinguiſhed for romantic ſituations. Were we to ſingle out any of the villages, we would mention Crieff, which ſtands on a fine ſloping ground on the north ſide of the Earn, and has been much admired by travellers for its ſituation, and the variety, contraſt, ſingularity, and beauty of the proſpect which it affords.

STRATHNAVER, a ſubdiviſion or diſtrict of the county of Sutherland in Scotland; bounded on the north by the ocean, on the eaſt by Caithneſs, on the ſouth by Sutherland properly ſo called, and on the weſt partly by Roſs and partly by the ocean.

STRATIOTES, WATER-SOLDIER, in botany: A genus of plants belonging to the claſs of *polyandria*, and to the order of *hexagynia*; and in the natural ſyſtem ranging under the firſt order, *palmæ*. The ſpatha is diphyllous: the perianthium is trifid. There are three petals, and the berry is ſix-celled and inferior. There are three ſpecies, the aloides, the acoroides, and aliſmoides. The *aloides* alone is of Britiſh extraction, which is alſo called the *water aloe*, or *freſh-water ſoldier*. The root conſiſts of long fibres tufted at the ends. The leaves are thick, triangular, pointed, and prickly at the edges. The flowers are white and floating on the water, and bloſſom in June. This plant may be ſeen in ſlow rivers and fens.

STRATO, a philoſopher of Lampſacus, diſciple and ſucceſſor in the ſchool of Theophraſtus, about 248 years before the Chriſtian era. He applied himſelf with uncommon induſtry to the ſtudy of nature; and after the moſt mature inveſtigations, he ſupported that nature was inanimate, and that there was no god but nature. (See *PLASTIC Nature*). He was appointed preceptor to Ptolemy Philadelphus, who not only revered his abilities and learning, but alſo rewarded his labours with unbounded liberality. He wrote different treatiſes, all now loſt.

STRAWBERRY, in botany. See FRAGARIA.

STRAWBERRY-Tree. See ARBUTUS.

END OF THE SEVENTEENTH VOLUME.

ERRATA.

Vol. III. p. 124. col. 2. l. 11. For "yet brought," read "not yet brought."
p. 258. col. 1. l. 20. For "in the 50th," read "in the 57th."

Vol. IX. p. 470. col. 1. l. 20. A correſpondent ſays, for "ſummer aſſizes," read "ſpring aſſizes."

Vol. X. p. 7. col. 2. l. 22. from bottom. For "iſoſceles rectangle," read "iſoſceles triangle."
p. 119. col. 1. l. 13. from bottom. For "αριθριϖ," read "αριθμός."
p. 471. col. 2. l. 27. For "prevents," read "perverts."
p. 542. col. 1. l. 1. from bottom. Eraſe the ſentence beginning with "It is an earldom."
p. 549. col. 2. l. 37. For "him," read "he."

Vol. XIII. p. 204. col. 2. l. 17. For "after the 364th, in the year 440," read "in the year 312, or, as Cedrenus ſays, in the year 393."

Vol. XIV. p. 67. col. 2. l. 27. For "St Claget," read "Dr Claget."

Vol. XVI. p. 196. col. 2. l. 23. Inſtead of the ſentence beginning with "In the mean time," read "On the 9th June Admiral Montague fell in with the French fleet returning to port, amounting to 19 ſail of the line."
p. 682. col. 1. l. 37. For "Milan," read "Miſnaw."
p. 696. col. 2. l. 3. For "σκηπτικος," read "σκεπτικος;" and for "σκεπτομην," read "σκεπτομαι."

Vol. XVII. p. 180. col. 2. l. 16. from bottom. For "covers them," read "it covers."
p. 524. col. 2. l. 12. For "where," read "when."
p. 533. col. 2. l. 30. After the word "likewiſe" add "poſſible."
p. 556. col. 2. l. 18. from bottom. Eraſe the ſentence beginning with the word "Candidates."
p. 671. col. 2. l. 23. Eraſe the word "*regius*."
p. 678. col. 2. l. 12. For "ανγικος," read "αγγικος."
p. 728. col. 2. l. 18. For "Balydrene," read "Balydrone."
p. 729. col. 1. l. 41. For "1669," read "1769."

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Negro. frizzled and ſparſe hair is to be accounted for in the very ſame manner.

Climate poſſeſſes great and evident influence on the hair, not only of men, but of all other animals. If in one caſe theſe tranſmutations are acknowledged to be conſiſtent with identity of kind, they ought not in the other to be eſteemed criterions of different ſpecies. Nature has adapted the pliancy of her work to the ſituations in which ſhe may require it to be placed. The beaver and ſheep removed to the warm latitudes exchange, the one its fur, and the other its wool, for a coarſe hair that preſerves the animal in a more moderate temperature. The coarſe and black ſhag of the bear is converted, in the arctic regions, into the fineſt and whiteſt fur. The colour of the hair is likewiſe changed by climate. The bear is white under the arctic circle; and, in high northern latitudes, foxes, hares, and rabbits, are found white. Similar effects of climate are diſcernible on mankind. The hair of the Danes is generally red; of the Engliſh, fair or brown; and of the French, commonly black. The hair of all people of colour is black, and that of the African negroes is likewiſe ſparſe and curled in a manner peculiar to themſelves; but this peculiarity is analogous to the effect which a warm climate has on almoſt every other animal. Cold, by obſtructing the perſpiration, tends to throw out the perſpirable matter accumulated at the ſkin in an additional coat of hair. A warm climate, by opening the pores, evaporates this matter before it can be concreted into the ſubſtance of hair; and the laxneſs and aperture of the pores render the hair liable to be eaſily eradicated by innumerable incidents. Its curl may reſult in part from the nature of the ſecretion by which it is nouriſhed, and in part from external heat. That it depends in ſome degree on the quality of the ſecretion is rendered highly probable from its appearance on the chin and other parts of the human body. Climate is as much diſtinguiſhed by the nature and proportion of the ſecretions as by the degree of heat: (See Physiology, ſect. 6.) Whatever be the nutriment of the hair, it is evidently combined in the torrid zone of Africa with ſome fluid of a highly volatile or ardent quality, which produces the rank ſmell of many African nations. Saline ſecretions tend to curl and to burn the hair. The evaporation of any volatile ſpirit would render its ſurface dry and diſpoſed to contract; whilſt the centre continuing diſtended by the vital motion, theſe oppoſite dilatations and contractions would neceſſarily produce a curve, and make the hair grow involved. External and violent heat parching the extremities of the hair, tends likewiſe to involve it. A hair held near the fire inſtantly coils itſelf up. Africa is the hotteſt country on the globe; and the influence of its heat, either external or internal, or both, in giving the peculiar form to the hair of the natives, appears, not only from its ſparſeneſs and its curl, but from its colour. It is not of a ſhining, but of an aduſt black; and its extremities tend to brown, as if it had been ſcorched by the fire.

The peculiarities of the negro-features and form may likewiſe be accounted for from the exceſſive heat of the climate and the ſtate of African ſociety. Being ſavages, they have no arts to protect them from the rays of a burning ſun. The heat and ſerenity of the ſky preſerving the lives of the children without much care of the parents, they ſeem of courſe to be, in the interior parts of the country, negligent of their offspring. Able themſelves to endure the extremes of that ardent climate, they inure their children to it from their moſt tender age. They ſuffer them to roll in the duſt and ſand beneath the direct rays of a vertical ſun. The mother, if ſhe be engaged, lays down the infant on the firſt ſpot ſhe finds, and is ſeldom at the pains to ſeek the miſerable ſhelter of a barren ſhrub, which is all that the interior country affords. When we reflect on the influence of a glare of light upon the eye, and on the contortions of countenance produced by our efforts to repel or prevent it, we need not wonder that the pliant features of a negro-infant ſhould, by conſtant expoſure, acquire that permanent irregularity which we term their characteriſtic uglineſs. But beſides the climate, food and clothing and modes of life have prodigious effects on the human form and features. This is apparent even in poliſhed ſocieties, where the poor and labouring part of the community are much more coarſe in their features, and ill-formed in their limbs, than perſons of better fortune and more liberal means of ſubſiſtence. What an immenſe difference exiſts in Scotland, for inſtance, between the chiefs and the commonalty of the Highland clans? If they had been ſeparately found in different countries, they would have been ranged by ſome philoſophers under different ſpecies. A ſimilar diſtinction takes place between the nobility and peaſantry of France, of Spain, of Italy, and of Germany. Negro.

That food and clothing, and the different modes of life, have as great an influence upon the ſhapes and features of the Africans as upon the natives of Europe, is evident from the different appearances of the negroes in the ſouthern republics of America according to the ſtations in which they are employed. "The field ſlaves (ſays Dr Smith) are badly fed, clothed, and lodged. They live in ſmall huts on the plantations, where they labour, remote from the ſociety and example of their ſuperiors. Living by themſelves, they retain many of the cuſtoms and manners of their African anceſtors. The domeſtic ſervants, on the other hand, who are kept near the perſons, or employed in the families of their maſters, are treated with great lenity; their ſervice is light; they are fed and clothed like their ſuperiors; they ſee their manners, adopt their habits, and inſenſibly receive the ſame ideas of elegance and beauty. The field ſlaves are, in conſequence, ſlow in changing the aſpect and figure of Africa. The domeſtic ſervants have advanced far before them in acquiring the agreeable and regular features, and the expreſſive countenance of civil ſociety. The former are frequently ill-ſhaped. They preſerve, in a great degree, the African lips, noſe, and hair. Their genius is dull, and their countenance ſleepy and ſtupid. The latter are ſtraight and well proportioned; their hair extended to three, four, and ſometimes even to ſix or eight inches; the ſize and ſhape of the mouth handſome, their features regular, their capacity good, and their look animated."

Upon the whole, we hope that the reader, who ſhall candidly weigh in his own mind what we have ſaid at preſent and under the article Complexion, will agree with us, that the black colour in the torrid zone, the ſparſe criſp hair of the negroes, and the peculiarities of their features and form, proceed from cauſes altogether extrinſic; that they depend on local temperature and the ſtate of ſociety; and that they are as accidental as the

This and the three following pages to be inſerted in place of p. 705, 706, 707, and 708, of Vol. XII.

Negro. various ſhades of colour which characterize the different nations of Europe. If the whites be conſidered as the ſtock whence all others have ſprung, it is eaſy to conceive how they have degenerated into negroes. Some have conjectured that the complete change may have taken place at the end of three centuries, whilſt others have thought that it could not be effected in leſs than double that period. Such conjectures can be formed from no certain data; and a much greater length of time is undoubtedly neceſſary before negroes, when tranſplanted into our temperate countries, can entirely loſe their black colour. By croſſing the breed with whites, every taint of the negro colour may be expelled, we believe, from the fifth generation (A).

But the moſt ſerious charge brought againſt the poor negroes is, that of the *vices* ſaid to be natural to them. If they be indeed ſuch as their enemies repreſent them, treacherous, cruel, revengeful, and intemperate, by a neceſſity of *nature*, they muſt be a different race from the whites; for though all theſe vices abound in Europe, it is evident that they proceed not from nature, but from wrong education, which gives to the youthful mind ſuch deep impreſſions as no future exertions can completely eradicate. Let us inquire coolly if the vices of the negroes may not have a ſimilar origin.

In every part of Africa with which the nations of Europe have any commerce, ſlavery prevails of the worſt kind. Three-fourths of the people are ſlaves to the reſt, and the children are born to no other inheritance. "Moſt parts of the coaſt differ in their governments; ſome are abſolute monarchies, while others draw near to an ariſtocracy. In both the authority of the chief or chiefs is unlimited, extending to life, and it is exerciſed as often as criminal caſes require, unleſs death is commuted into ſlavery; in which caſe the offender is ſold, and if the ſhipping will not buy the criminal, he is immediately put to death. Fathers of free condition have power to ſell their children, but this power is very ſeldom enforced." In Congo, however, a father * will ſell a ſon or daughter, or perhaps both, for a piece of cloth, a collar or girdle of coral or beads, and often for a bottle of wine or brandy. A huſband may have as many wives as he pleaſes, and repudiate or even ſell them, though with child, at his pleaſure. The wives and concubines, though it be a capital crime for the former to break the conjugal faith, have a way to rid themſelves of their huſbands, if they have ſet their affections upon a new gallant, by accuſing them of ſome crime for which the puniſhment is death. In a word, the bulk of the people in every ſtate of Africa are born ſlaves to great men, reared as ſuch, held as property, and as property ſold (ſee SLAVERY). There are indeed many circumſtances by which a free man may become a ſlave: ſuch as being in debt, and not able to pay; and in ſome of ſuch caſes, if the debt be large, not only the debtor, but his family likewiſe, become the ſlaves of his creditor, and may be ſold. Adultery is commonly puniſhed in the ſame manner, both the offending parties being ſold, and the purchaſe-money paid to the injured huſband. *Obi*, or pretended witchcraft (in which all the negroes firmly believe, ſee WITCHCRAFT), is another, and a very common offence, for which ſlavery is adjudged the lawful puniſhment; and it extends to all the family of the offender. There are various other crimes which ſubject the offender and his children to be ſold; and it is more than probable, that if there were no buyers, the poor wretches would be murdered without mercy.

Negro. *Edwards's Hiſtory of the Weſt Indies.*

In ſuch a ſtate of ſociety, what diſpoſitions can be looked for in the people, but cruelty, treachery, and revenge? Even in the civilized nations of Europe, bleſſed with the lights of law, ſcience, and religion, ſome of the lower orders of the community conſider it as a very trivial crime to defraud their ſuperiors; whilſt almoſt all look up to them with ſtupid malevolence or rancorous envy. That a depreſſed people, when they get power into their hands, are revengeful and cruel, the preſent age affords a dreadful proof in the conduct of the demagogues of a neighbouring nation; and is it wonderful that the negroes of Africa, unacquainted with moral principles, blinded by the cruelleſt and moſt abſurd ſuperſtitions, and whoſe cuſtoms tend to eradicate from the mind all natural affection, ſhould ſometimes diſplay to their lordly maſters of European extraction the ſame ſpirit that has been ſo generally diſplayed by the lower orders of Frenchmen to their eccleſiaſtics, their nobles, and the family of their murdered ſovereign! When we conſider that the majority of the negroes groan under the cruelleſt ſlavery, both in their own country and in every other where they are to be found in conſiderable numbers, it can excite no ſurpriſe that they are in general treacherous, cruel, and vindictive. Such are the caprices of their tyrants at home, that they could not preſerve their own lives or the lives of their families for any length of time, but by a perpetual vigilance, which muſt neceſſarily degenerate, firſt into cunning, and afterwards into treachery; and it is not conceivable that habits formed in Africa ſhould be inſtantly thrown off in the Weſt Indies, where they are the property of men whom ſome of them muſt conſider as a different race of beings.

Edwards's Hiſtory of the Weſt Indies, vol. ii.

* *Mod. Univ. Hiſtory*, vol. xiii. 1. 55.

But

(A) 1. A white man with a negro woman, or a negro man with a white woman, produce a mulatto, half white and half black, or of a yellow-blackiſh colour, with black, ſhort, frizzled hair. 2. A white man with a mulatto woman, or a negro with a mulatto woman, produce a *quadroon*, three fourths white and one fourth black, or three fourths black and one fourth white, or of a lighter yellow than the former. In America, they give the name of *cabres* to thoſe who are deſcended from a black man and a mulatto woman, or a mulatto man and a black woman, who are three fourths black and one fourth white, and who are not ſo black as a negro, but blacker than a mulatto. 3. A white man with a quadroon woman, or a negro with a quadroon woman, produce a *meſtizo*, ſeven eighths white and one eighth black, or ſeven eighths black and one eighth white. 4. A white man with a meſtizo woman, or a negro with a meſtizo woman, produce, the one almoſt a perfect white, the other almoſt a perfect black, called a *quinteroon*. This is the laſt gradation, there being no viſible difference between the fair quinteroons and the whites; and the children of a white and quinteroon conſider themſelves as free from all taint of the negro race.

Negro. But the truth is, that the ill qualities of the negroes have been greatly exaggerated. Mr Edwards, in his valuable Hiſtory of the Weſt Indies, aſſures us that the Mandingo negroes diſplay ſuch gentleneſs of diſpoſi- and demeanour, as would ſeem the reſult of early education and diſcipline, were it not that, generally ſpeaking, they are more prone to theft than any of the African tribes. It has been ſuppoſed that this propenſity, among other vices, is natural to a ſtate of ſlavery, which degrades and corrupts the human mind in a deplorable manner; but why the Mandingoes ſhould have become more vicious in this reſpect than the reſt of the natives of Africa in the ſame condition of life, is a queſtion he cannot anſwer.

"The circumſtances which (according to the ſame author) diſtinguiſh the Koromantyn or Gold Coaſt negroes from all others, are firmneſs both of body and mind; a ferociouſneſs of diſpoſition; but withal, activity, courage, and a ſtubbornneſs, or what an ancient Roman would have deemed an elevation of ſoul, which prompts them to enterpriſes of difficulty and danger, and enables them to meet death, in its moſt horrible ſhape, with fortitude or indifference. They ſometimes take to labour with great promptitude and alacrity, and have conſtitutions well adapted for it; for many of them have undoubtedly been ſlaves in Africa. But as the Gold Coaſt is inhabited by various tribes, which are engaged in perpetual warfare and hoſtility with each other, there cannot be a doubt that many of the captives taken in battle, and ſold in the European ſettlements, were of free condition in their native country, and perhaps the owners of ſlaves themſelves. It is not wonderful that ſuch men ſhould endeavour, even by means the moſt deſperate, to regain the freedom of which they have been deprived; nor do I conceive that any further circumſtances are neceſſary to prompt them to action, than that of being ſold into captivity in a diſtant country. One cannot ſurely but lament (ſays our author), that a people thus naturally intrepid, ſhould be ſunk into ſo deplorable a ſtate of barbarity and ſuperſtition; and that their ſpirits ſhould ever be broken down by the yoke of ſlavery! Whatever may be alleged concerning their ferociouſneſs and implacability in their preſent notions of right and wrong, I am perſuaded that they poſſeſs qualities which are capable of, and well deſerve, cultivation and improvement.

"Very different from the Koromantyns are the negroes imported from the Bight of Benin, and known in the Weſt Indies by the name of Eboes. So great is their conſtitutional timidity and deſpondency of mind as to occaſion them very frequently to ſeek, in a voluntary death, a refuge from their own melancholy reflections. They require therefore the gentleſt and mildeſt treatment to reconcile them to their ſituation; but if their confidence be once obtained, they manifeſt as great fidelity, affection, and gratitude, as can reaſonably be expected from men in a ſtate of ſlavery. The females of this nation are better labourers than the men, probably from having been more hardly treated in Africa.

"The natives of Whidah, who, in the Weſt Indies, are generally called *Papaws*, are unqueſtionably the moſt docile and beſt-diſpoſed ſlaves that are imported from any part of Africa. Without the fierce and ſavage manners of the Koromantyn negroes, they are alſo happily exempt from the timid and deſponding temper of the Eboes. The cheerful acquieſcence with which theſe people apply to the labours of the field, and their conſtitutional aptitude for ſuch employment, ariſe, without doubt, from the great attention paid to agriculture in their native country. Boſman ſpeaks with rapture of the improved ſtate of the ſoil, the number of villages, and the induſtry, riches, and obliging manners of the natives. He obſerves, however, that they are much greater thieves than thoſe of the Gold Coaſt, and very unlike them in another reſpect, namely, in the dread of pain, and the apprehenſion of death. They are, ſays he, ſo very apprehenſive of death, that they are unwilling to hear it mentioned, for fear *that* alone ſhould haſten their end; and no man dares to ſpeak of death in the preſence of the king, or any great man, under the penalty of ſuffering it himſelf, as a puniſhment for his preſumption. He relates further, that they are addicted to gaming beyond any people of Africa. All theſe propenſities are obſervable in the character of the Papaws in a ſtate of ſlavery in the Weſt Indies. That puniſhment which excites the Koromantyn to rebel, and drives the Ebo negro to ſuicide, is received by the Papaws as the chaſtiſement of legal authority, to which it is their duty to ſubmit patiently. The caſe ſeems to be, that the generality of theſe people are in a ſtate of abſolute ſlavery in Africa, and, having been habituated to a life of labour, they ſubmit to a change of ſituation with little reluctance."

Having recited ſuch obſervations as occurred to him on contemplating the various tribes of negroes from each other, Mr Edwards thus eſtimates their general character, influenced as they are by circumſtances which ſoon efface the native and original impreſſions which diſtinguiſh one nation from another when newly imported into the Weſt Indies.

"Notwithſtanding what has been related of the firmneſs and courage of the natives of the Gold Coaſt, it is certain that the negroes in general in our iſlands (ſuch of them at leaſt as have been any length of time in a ſtate of ſervitude) are of a diſtruſtful and cowardly diſpoſition. So degrading is the nature of ſlavery, that fortitude of mind is loſt as free agency is reſtrained. To the ſame cauſe probably muſt be imputed their propenſity to conceal or violate the truth; which is ſo general, that the vice of falſehood is one of the moſt prominent features in their character. If a negro is aſked even an indifferent queſtion by his maſter, he ſeldom gives an immediate reply; but, affecting not to underſtand what is ſaid, compels a repetition of the queſtion, that he may have time to conſider, not what is the true anſwer, but what is the moſt politic one for him to give. The proneneſs obſervable in many of them to the vice of theft has already been noticed; and I am afraid (ſays our author), that evil communication makes it almoſt general. It is no eaſy matter, I confeſs, to diſcriminate thoſe circumſtances which are the reſult of proximate cauſes, from thoſe which are the effects of national cuſtoms and early habits in ſavage life; but I am afraid that cowardice and diſſimulation have been the properties of ſlavery in all ages, and will continue to be ſo to the end of the world. It is a ſituation that neceſſarily ſuppreſſes many of the beſt affections of the human heart.

Negro. Negroland.

heart.—If it calls forth any latent virtues, they are thoſe of ſympathy and compaſſion towards perſons in the ſame condition of life; and accordingly we find that the negroes in general are ſtrongly attached to their countrymen, but above all, to ſuch of their companions as came in the ſame ſhip with them from Africa. This is a ſtriking circumſtance: the term *ſhipmate* is underſtood among them as ſignifying a relationſhip of the moſt endearing nature; perhaps as recalling the time when the ſufferers were cut off together from their common country and kindred, and awakening reciprocal ſympathy from the remembrance of mutual affliction. But their benevolence, with a very few exceptions, extends no further. The ſofter virtues are ſeldom found in the boſom of the enſlaved African. Give him ſufficient authority and he becomes the moſt remorſeleſs of tyrants. Of all the degrees of wretchedneſs endured by the ſons of men, the greateſt, aſſuredly, is the miſery which is felt by thoſe who are unhappily doomed to be the ſlaves of ſlaves; a moſt unnatural relation, which ſometimes takes place in the ſugar plantations. The ſame obſervation may be made concerning their conduct towards the animal creation. Their treatment of cattle under their direction is brutal beyond belief. Even the uſeful and ſocial qualities of the dog ſecure to him no kind uſage from an African maſter. One of the moſt pleaſing traits in their character is the reſpect and attention which they pay to their aged countrymen. The whole body of negroes on a plantation muſt be reduced to a deplorable ſtate of wretchedneſs, if, at any time, they ſuffer their aged companions to want the common neceſſaries of life, or even many of its comforts, as far as they can procure them. They ſeem to be actuated on theſe occaſions by a kind of involuntary impulſe, operating as a primitive law of nature, which ſcorns to wait the cold dictates of reaſon: among them, it is the exerciſe of a common duty, which courts no obſervation, and looks for no applauſe."

As the colour, and features, and moral qualities of the negroes may be thus eaſily accounted for by the influence of climate and the modes of ſavage life, ſo there is good reaſon to believe that their intellectual endowments are equal to thoſe of the whites who have been found in the ſame circumſtances. Of thoſe imitative arts in which perfection can be attained only in an improved ſtate of ſociety, it is natural to ſuppoſe that they have but little knowledge; but the fabric and colours of the Guinea cloths are a proof of their native ingenuity. In the Weſt Indies many of them are expert carpenters, ſome watchmakers, and one or two have ſucceſsfully practiſed phyſic; whilſt others have figured both in Latin and in Engliſh poetry, ſo that we cannot doubt but that "God, who made the world, hath made of one blood all nations of men," and animated them with minds equally rational.

NEGROLAND, or NIGRITIA, a country of Africa, lying next to Guinea towards the north, and extending from 18° of weſt to 23° of eaſt longitude, and from 9° to 20° of north latitude. On the north it is bounded by Zara or the Deſert; on the eaſt, by countries unknown; on the ſouth, by Guinea; and on the weſt, by the Atlantic Ocean; and is watered by the great river Niger or Senegal, which runs through it from eaſt to weſt. The Europeans have ſettlements on the coaſts of this country, eſpecially near the mouths of the Niger and Gambia, which laſt is ſuppoſed to be a branch of the former. A great many nations inhabit the banks of the rivers; ſome Pagans, ſome Mohammedans, of different languages, and independent of one another. The country is fruitful, eſpecially along the rivers; abounding in rice, Guinea grain, and Indian corn, where it is cultivated; and with cocoa-nuts, plantains, pulſe, palm-trees, and tropical fruits; nor is it deſtitute of cattle, and a variety of other animals, particularly ſuch as abound in Guinea. See GUINEA.

Negroland.

Negroland is fertilized by the overflowing of its rivers the Senegal and Gambia, as Egypt is by the Nile. It hath not yet been aſcertained whether the Gambia is a branch of the Senegal or not. As far as the Europeans have penetrated up the country, they appear to be diſtinct; and the Mundingo Negroes report that the Gambia has a different origin. The entrance into the Niger or Senegal river is narrow and ſomewhat difficult, by reaſon of its immoveable bar and ſandy ſhoals, as well as the ſeveral iſlands at the mouth of it, and the ſeveral canals and marſhes that clog it: but after ſailing up eight or ten leagues, it is found broad and deep, and fit to carry large veſſels; and, excepting about five or ſix leagues on each ſide above the mouth, which is ſandy and barren ground, the banks are covered with ſtately trees and villages, and the country in general is fertile and well watered; for, like the Nile, this river overflows its banks for many leagues, and enriches the land to a great degree, though, for want of ſkill, the inhabitants do not reap the advantages which they might obtain from its fertility. The people on both ſides of the river live as near to it as they can, and feed great herds of cattle, ſowing large and ſmall millet, the former of which is called by us *Turkey wheat*, in great quantities, and with great increaſe. If the river fails of overflowing at its uſual ſeaſon, a great ſcarcity enſues in the adjacent country; and, even when it overflows regularly, it breeds ſuch vaſt flights of graſshoppers and inſects, as quite darken the air, and frequently devour all the product of the earth: in which caſe the people kill thoſe inſects and eat them; which they do either by pounding in leathern bags, and then boiling them in milk, or, which is reckoned the more delicious method, by frying or broiling them over a light blaze in a frying-pan full of holes. Thus the legs and wings of the inſects are burnt off, and the reſt of the body is ſufficiently roaſted to be eaten as a dainty, which they look upon to be very wholeſome and nouriſhing.

To the eaſt, north-eaſt, and ſouth-eaſt of the iſland of Senegal, the country, as far as it is known, is over-run with woods and marſhes; the Senegal, Gambia, and Sherbro, which are looked upon by ſome as branches of one immenſe river, paſſing through it in their way to the Atlantic Ocean. During the rainy months, which begin in July, and continue to October, they lay the whole country under water; and indeed the ſudden riſe of theſe rivers is incredible to ſuch as are not acquainted with the violent rains that fall between the tropics. At Galam, 900 miles from the mouth of the Senegal, the waters riſe 150 feet perpendicular from the bed of the river. At the iſland of Senegal, the river riſes gradually, during the rainy

ſeaſon,

Sanhedrim

fively at Gilgal, at Shiloh, at Kirjath-jearim, at Nob, at Gibeon in the houſe of Obed-edom; and laſtly, it was ſettled at Jeruſalem, till the Babyloniſh captivity. During the captivity it was kept up at Babylon. After the return from Babylon, it continued at Jeruſalem to the time of the Sicarii, or Aſſaſſins. Then finding that theſe profligate wretches, whoſe number increaſed every day, ſometimes eſcaped puniſhment by the favour of the preſident or judges, it was removed to Hanoth, which were certain abodes ſituated, as the rabbins tell us, upon the mountain of the temple. From thence they came down into the city of Jeruſalem, withdrawing themſelves by degrees from the temple. Afterwards they removed to Jamnia, thence to Jericho, to Uzzah, to Sepharvaim, to Bethſanim, to Sephoris, laſt of all to Tiberias, where they continued to the time of their utter extinction. And this is the account the Jews themſelves give us of the ſanhedrim.

But the learned do not agree with them in all this. Father Petau fixes the beginning of the ſanhedrim not till Gabinius was governor of Judea, who, according to Joſephus, erected tribunals in the five principal cities of Judea; at Jeruſalem, at Gadara, at Amathus, at Jericho, and at Sephora or Sephoris, a city of Galilee. Grotius places the origin of the ſanhedrim under Moſes, as the rabbins do; but he makes it determine at the beginning of Herod's reign. Mr Baſnage at firſt thought that the ſanhedrim began under Gabinius; but afterwards he places it under Judas Maccabæus, or under his brother Jonathan. We ſee indeed, under Jonathan Maccabæus, (1 Macc. xii. 6.), in the year 3860, that the ſenate with the high-prieſt ſent an embaſſy to the Romans. The rabbins ſay, that Alexander Janneus, king of the Jews, of the race of the Aſmonæans, appeared before the ſanhedrim, and claimed a right of ſitting there, whether the ſenators would or not. Joſephus informs us, that when Herod was but yet governor of Galilee, he was ſummoned before the ſenate, where he appeared. It muſt be therefore acknowledged, that the ſanhedrim was in being before the reign of Herod. It was in being afterwards, as we find from the Goſpel and from the Acts. Jeſus Chriſt in St Matthew (v. 22.) diſtinguiſhes two tribunals.—"Whoſoever is angry with his brother without a cauſe ſhall be in danger of the judgment." This, they ſay, is the tribunal of the 23 judges. "And whoſoever ſhall ſay to his brother Raca, ſhall be in danger of the council;" that is, of the great ſanhedrim, which had the right of life and death, at leaſt generally, and before this right was taken away by the Romans. Some think that the juriſdiction of the council of 23 extended to life and death alſo; but it is certain that the ſanhedrim was ſuperior to this council. See alſo Mark xiii. 9. xiv. 55. xv. 1.; Luke xxii. 52, 66.; John xi. 47.; Acts iv. 15. v. 21. where mention is made of the ſynedrion, or ſanhedrim.

From all this it may be concluded, that the origin of the ſanhedrim is involved in uncertainty; for the council of the 70 elders eſtabliſhed by Moſes was not what the Hebrews underſtand by the name of ſanhedrim. Beſides, we cannot perceive that this eſtabliſhment ſubſiſted either under Joſhua, the judges, or the kings. We find nothing of it after the captivity, till the time of Jonathan Maccabæus. The tribunals erected by Gabinius were very different from the ſanhedrim, which was the ſupreme court of judicature, and fixed at Jeruſalem; whereas Gabinius eſtabliſhed five at five different cities. Laſtly, it is certain that this ſenate was in being in the time of Jeſus Chriſt; but the Jews themſelves inform us that they had no longer then the power of life and death (John xviii. 31.)

Sanjack li Sannazarius.

SANJACKS, a people inhabiting the Curdiſtan, or Perſian mountains, ſubſiſting chiefly by plunder, and the ſcanty pittance afforded by their own mountainous country. "They were much reduced (ſays Mr Ives) by the late baſhaw Achmet of Bagdad, who purſued them in perſon to their ſubterranean retreats, and deſtroyed many by the ſword, and carried off great numbers of priſoners, who were ſold for ſlaves." Notwithſtanding this check, in the year 1758, they were again become ſo daring that they would attack caravans of 700 men, and ſometimes carry all off. They are ſaid to be worſhippers of the evil principle.

Ives's Voyage to India, &c.

SAN JUAN DE PUERTO RICO, uſually called *Porto Rico*, one of the Weſt India iſlands belonging to Spain, is ſituated in about 18. N. Lat. and between 65. 36. and 67. 45. W. Long. and is about 40 leagues long and 20 broad. The iſland is beautifully diverſified with woods, valleys, and plains, and is extremely fertile. It is well watered with ſprings and rivers, abounds with meadows, is divided by a ridge of mountains running from eaſt to weſt, and has a harbour ſo ſpacious that the largeſt ſhips may lie in it with ſafety. Before the arrival of the Spaniards it was inhabited by 4 or 500,000 people, who, in a few years, were extirpated by its mercileſs conquerors. Raynal ſays, that its whole inhabitants amounts at preſent only to 1500 Spaniards, Meſtoes, and Mulattoes, and about 3000 negroes. Thus one of the fineſt iſlands in the Weſt Indies has been depopulated by the cruelty, and left uncultivated by the indolence, of its poſſeſſors. But it is the appointment of Providence, who ſeldom permits flagrant crimes to paſs unpuniſhed, that poverty and wretchedneſs ſhould be uniform conſequences of oppreſſion.

SANICULA, SANICLE, or *Self-heal*, in botany: A genus of the digynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 45th order, *Umbellatæ*. The umbels are cloſe together, almoſt in a round head; the fruit is ſcabrous; the flowers of the diſk abortive. There are three ſpecies, viz. the canadenſis, marilandica, and europæa, found in many parts both of Scotland and England. This plant was long celebrated for its healing virtues; but it is now totally diſregarded.

SANIDIUM, in natural hiſtory, the name of a genus of foſſils of the claſs of the ſelenitæ, but neither of the rhomboidal nor columnar kinds, nor any other way diſtinguiſhable by its external figure; being made up of ſeveral plain flat plates.

SANIES, in medicine, a ſerous putrid matter, iſſuing from wounds. It differs from pus, which is thicker and whiter.

SANNAZARIUS (James), in Latin *Actius Cincenis Sannazarius*, a celebrated Latin and Italian poet, born at Naples in 1458. He by his wit ingratiated himſelf into the favour of king Frederic; and, when that prince was dethroned, attended him into France, where he ſtaid with him till his death, which happened in 1504. Sannazarius then returned into Italy, where he applied himſelf to polite literature, and particularly

This and the following page to be inſerted in place of pages 651 and 652 of Vol. XVI.

Santa. to Latin and Italian poetry. His gay and facetious humour made him ſought for by all companies; but he was ſo afflicted at the news that Phillibert prince of Orange, general of the emperor's army, had demoliſhed his country-houſe, that it threw him into an illneſs, of which he died in 1530. It is ſaid, that being informed a few days before his death, that the prince of Orange was killed in battle, he called out, "I ſhall die contented, ſince Mars has puniſhed this barbarous enemy of the Muſes." He wrote a great number of Italian and Latin poems: among thoſe in Latin, his *De Partu Virginis* and Eclogues are chiefly eſteemed; and the moſt celebrated of his Italian pieces is his *Arcadia*.

SANTA CRUZ, a large iſland in the South Sea, and one of the moſt conſiderable of thoſe of Solomon, being about 250 miles in circumference. W. Long. 130. 0. S. Lat. 10. 21.

SANTA CRUZ, or St CROIX, a ſmall and unhealthy iſland, ſituated in about 64 degrees weſt longitude and 18 north latitude. It is about eighteen leagues in length, and from three to four in breadth. In 1643 it was inhabited by Dutch and Engliſh, who ſoon became enemies to each other; and in 1650 were both driven out by 1200 Spaniards, who arrived there in five ſhips. The triumph of theſe laſted but a few months. The remains of that numerous body, which were left for the defence of the iſland, ſurrendered without reſiſtance to 160 French, who had embarked in 1651, from St Chriſtopher's, to make themſelves maſters of the iſland.

Raynal's Hiſtory of the Eaſt and Weſt Indies, vol. 4th, p. 298.

Theſe new inhabitants loſt no time in making themſelves acquainted with a country ſo much diſputed. On a ſoil, in other reſpects excellent, they found only one river of a moderate ſize, which, gliding gently almoſt on a level with the ſea through a flat country, furniſhed only a brackiſh water. Two or three ſprings, which they found in the innermoſt parts of the iſland, made but feeble amends for this defect. The wells were for the moſt part dry. The conſtruction of reſervoirs required time. Nor was the climate more inviting to the new inhabitants. The iſland being flat, and covered with old trees, ſcarce afforded an opportunity for the winds to carry off the poiſonous vapours with which its moraſſes clogged the atmoſphere. There was but one remedy for this inconvenience; which was to burn the woods. The French ſet fire to them without delay; and, getting on board their ſhips, became ſpectators from the ſea, for ſeveral months, of the conflagration they had raiſed in the iſland. As ſoon as the flames were extinguiſhed, they went on ſhore again.

They found the ſoil fertile beyond belief. Tobacco, cotton, arnotto, indigo, and ſugar, flouriſhed equally in it. So rapid was the progreſs of this colony, that in 11 years from its commencement there were upon it 822 white perſons, with a proportionable number of ſlaves. It was rapidly advancing to proſperity, when ſuch obſtacles were thrown in the way of its activity as made it decline again. This decay was as ſudden as its riſe. In 1696 there were no more than 147 men, with their wives and children, and 623 blacks remaining; and theſe were tranſported to St Domingo.

Some obſcure individuals, ſome writers unacquainted with the views of government, with their ſecret negotiations, with the character of their miniſters, with the intereſts of the protectors and the protected, who flatter themſelves that they can diſcern the reaſon of events amongſt a multitude of important or frivolous cauſes, which may have equally occaſioned them; who do not conceive, that among all theſe cauſes the moſt natural may poſſibly be the fartheſt from the truth; who after having read the news, or journal of the day, with profound attention, decide as peremptorily as if they had been placed all their lifetime at the helm of the ſtate, and had aſſiſted at the council of kings; who are never more deceived than in thoſe circumſtance in which they diſplay ſome ſhare of penetration; writers as abſurd in the praiſes as in the blame which they beſtow upon nations, in the favourable or unfavourable opinion they form of miniſterial operations: theſe idle dreamers, in a word, who think they are perſons of importance, becauſe their attention is always engaged on matters of conſequence, being convinced that courts are always governed in their deciſions by the moſt comprehenſive views of profound policy, have ſuppoſed that the court of Verſailles had neglected Santa Cruz, merely becauſe they wiſhed to abandon the ſmall iſlands in order to unite all their ſtrength, induſtry, and population, in the large ones; but this is a miſtaken notion. This determination aroſe from the farmers of the revenue, who found that the contraband trade of Santa Cruz with St Thomas was detrimental to their intereſts. The ſpirit of finance hath in all times been injurious to commerce; it hath deſtroyed the ſource from whence it ſprang. Santa Cruz continued without inhabitants, and without cultivation, till 1733, when it was ſold by France to Denmark for 30,750l. Soon after the Danes built there the fortreſs of Chriſtianſtadt. Then it was that this northern power ſeemed likely to take deep root in America. Unfortunately, ſhe laid her plantations under the yoke of excluſive privileges. Induſtrious people of all ſects, particularly Moravians, ſtrove in vain to overcome this great difficulty. Many attempts were made to reconcile the intereſts of the coloniſts and their oppreſſors, but without ſucceſs. The two parties kept up a continual ſtruggle of animoſity, not of induſtry. At length the government, with a moderation not to be expected from its conſtitution, purchaſed, in 1754, the privileges and effects of the company. The price was fixed at L. 412,500, part of which was paid in ready money, and the remainder in bills upon the treaſury, bearing intereſt. From this time the navigation to the iſlands was opened to all the ſubjects of the Daniſh dominions. Of 345 plantations, which were ſeen at Santa Cruz, 150 were covered with ſugar canes, and every habitation is limited to 3000 Daniſh feet in length, and 2000 in breadth. It is inhabited by 2136 white men, by 22,244 ſlaves, and by 155 freedmen.

SANTA CRUZ, in Teneriff. See TENERIFF.

SANTA CRUZ, a town of Africa, on the coaſt of Barbary, and in the province of Suez and kingdom of Morocco, with a harbour and a fort. The Moors took it from the Portugueſe in 1536. It is ſeated at the extremity of Mount Atlas, on the Cape Aguer. W. Long. 10. 7. N. Lat. 30. 38.

SANTA CRUZ de la Sierra, a town of South America, and capital of a province of that name in Peru, and in the audience of Los Charcas, with a biſhop's

ſee.

Santorini || Sap.

border of light freſh earth, but muſt be watered and ſhaded in hot dry weather, until they have taken root; after which they will require no farther care but to keep them clean from weeds till autumn, when they ſhould be tranſplanted where they are deſigned to remain: but if the ground is not ready by that time to receive them, it will be proper to let them remain in the border until ſpring; for if they are tranſplanted late in autumn, they are liable to be deſtroyed by cold in winter.

SANTORINI, an iſland of the Archipelago, to the north of Candia, and to the ſouth-weſt of Nanphio. It is eight miles in length, and near as much in breadth, and almoſt covered with pumice-ſtone, whence the ſoil in general muſt be dry and barren; it is, however, greatly improved by the labour and induſtry of the inhabitants, who have turned it into a garden. It affords a great deal of barley, plenty of cotton, and large quantities of wine. Fruit is ſcarce except figs; and they have neither oil nor wood. The inhabitants are all Greeks, and are about 10,000 in number. Pyrgos is the capital town, and there are ſeveral little towns and villages. They have but one ſpring in the iſland, for which reaſon they preſerve the rain-water in ciſterns. Though ſubject to the Turks, they chooſe their own magiſtrates. E. Long. 25. 5. N. Lat. 39. 10.

SANZIO (Raphael). See RAPHAEL.

SAO, a territory, called a kingdom, of Africa, on the gold-coaſt of Guinea, hardly two miles in length along the ſhore. It produces abundance of Indian corn, yams, potatoes, palm-wine, and oil. The inhabitants are very treacherous, and there is no dealing with them without a great deal of caution. It contains ſeveral villages, of which Sabo is the principal; and the Dutch have a fort here called *Naſſau*.

SAONE, a conſiderable river of France, which has its ſource in mount Voſgue, near Darney; runs through the Franche Comte, Burgundy, Beaujolois; and falls into the Rhone at Lyons. It paſſes by Gray, Chalons, and Maſcon.

SAP, the juice found in vegetables.

We obſerved, when treating of PLANTS, that it has been long diſputed whether the ſap of plants be analogous to the blood of animals, and circulates in the ſame manner. We alſo mentioned the concluſions that Dr Halesdrew from his numerous experiments, which were all in oppoſition to the doctrine that the ſap circulates. As the ſubject is curious and intereſting, and as additional light has been thrown upon it of late years, we wiſh to communicate it to our readers as fully as our limits will permit.

As the vegetable economy is ſtill but imperfectly underſtood, and experiments made for tracing the motion of the ſap may lead to important diſcoveries, we are happy to find, that of late years this ſubject has been again revived. Dr Walker, profeſſor of Natural Hiſtory in the univerſity of Edinburgh, has publiſhed in the 1ſt volume of the Philoſophical Tranſactions of Edinburgh an account of a courſe of very accurate and ingenious experiments, accompanied with obſervations and concluſions made with a caution which inſpires confidence, and is indeed worthy of a diſciple of Bacon. He is the firſt perſon, as far as we know, who thought of comparing the thermometer with the motion of the ſap.

Sap.

It is well known that in the ſpring vegetables contain a great quantity of ſap; and there are ſome trees, as the birch and plane, which, if wounded, will diſcharge a great portion of it. Whence is this moiſture derived? Whether is it imbibed from the atmoſphere, or does it flow from the ſoil through the roots? Theſe are the queſtions which require firſt to be anſwered; and Dr Walker's experiments enable us to anſwer them with confidence.

He ſelected a vigorous young birch, 30 feet high and 26 inches in circumference at the ground. He bored a hole juſt above the ground on the 1ſt of February, and cut one of its branches at the extremity. He repeated this every ſecond day; but no moiſture appeared at either of the places till the 5th of May, when a ſmall quantity flowed on making an inciſion near the ground. He then cut 21 inciſions in the trunk of the tree, on the north ſide, at the diſtance of a foot from one another, and reaching from the ground to the height of 20 feet. The inciſions were ſolid triangles, each ſide being an inch long and an inch deep, and penetrating through the bark and wood. Dr Walker viſited the tree almoſt every day for two months, and marked exactly from which of the inciſions the ſap flowed. He obſerved that it flowed from the loweſt inciſion firſt, and gradually aſcended to the higheſt. The following table will ſhow the progreſs of the ſap upwards, and its correſpondence with the thermometer.

The firſt column is the day of the month on which the obſervation was made; the ſecond expreſſes the number of inciſions from which the ſap flowed on the day of the month oppoſite; and the third column the degree of the thermometer at noon. Some days are omitted in March, as the inciſions, though made on the 5th, did not bleed till the 11th. Some days are alſo paſſed over in April, becauſe no obſervation was made on account of rain.

March.	N. of In.	Ther. Noon.	March.	N. of In.	Ther. Noon.
5	—	46	30	8	50
11	2	49	31	7	62
12	2	49			
13	1	44	April 2	7	46
14	4	48	4	10	53
15	5	52	7	11	49
16	5	47	8	11	48
17	4	44	9	12	50
18	5	47	10	13	53
19	6	48	11	13	45
20	5	44	12	13	44
21	7	48	13	13	43
22	7	45	14	14	55
23	8	46	15	14	49
24	9	47	16	16	56
25	9	42	18	16	50
26	7	39	19	17	54
27	8	45	20	19	56
28	8	49	21	20	54
29	8	46	22	21	52

Dr Walker found that the ſap aſcends through the wood, and ſtill more copiouſly between the wood and the bark; but none could be perceived aſcending through the pith or the bark. He found alſo, that when the thermometer at noon is about 49, or between 46 and 50, the ſap riſes about one foot in 24 hours; that when the thermometer is about 45 at noon, it aſcends about one

Sap, Sapindus.

one foot in two days; and that it does not aſcend at all unleſs the mid-day heat be above 40. He obſerved that it moves with more velocity through young than through old branches. In one young branch it moved through ſeven feet in one day, the thermometer being at 49, while it moved in the trunk of the tree only ſeven feet in ſeven days. Dr Walker has thus explained the reaſon why the buds on the extremities of branches unfold firſt; becauſe they are placed on the youngeſt wood, to which the ſap flows moſt abundantly.

The effects produced by the motion of the ſap deſerve to be attended to. In thoſe parts to which it has mounted, the bark eaſily ſeparates from the wood, and the ligneous circles may, without difficulty, be detached from one another. The buds begin to ſwell and their ſcales to ſeparate, while thoſe branches to which the ſap has not aſcended remain cloſely folded. When the ſap has reached the extremities of the branches, and has thus pervaded the whole plant, it is ſoon covered with opening buds and ceaſes to bleed. The bleeding ceaſes firſt in the upper parts of the tree, and in the lower parts ſucceſſively downwards, and the wood becomes dry. An inverted branch flows more copiouſly when cut than thoſe which are erect. This is a proof that the aſcent of the ſap is not occaſioned by capillary attraction, for water which has riſen in a ſmall glaſs tube by this attraction will not deſcend when the tube is inverted.

It is evident that there is an intimate connection between heat and the aſcent of the ſap. It did not begin to flow till the thermometer ſtood at a certain point: when it fell below 40, it was arreſted in its progreſs. The ſouth ſide of the tree, when the ſun was bright, bled more profuſely than the north ſide; and at ſun-ſet the inciſions at the top ceaſed to bleed, where it was expoſed moſt to the cold air, while it ſtill continued to flow from the inciſions next to the ground; the ground retaining its heat longer than the air.

SAP, in ſieges, is a trench, or an approach made under cover of 10 or 12 feet broad, when the beſiegers come near the place, and the fire from the garriſon grows ſo dangerous that they are not able to approach uncovered.—There are ſeveral ſorts of ſaps; the ſingle, which has only a ſingle parapet; the double, having one on each ſide; and the flying, made with gabions, &c. In all ſaps traverſes are left to cover the men.

SAPINDUS, the SOAP-BERRY TREE, in botany: A genus of the digynia order, belonging to the octandria claſs of plants; and in the natural method ranking under the 23d order, *Tribilatæ*. The calyx is tetraphyllous; the petals four; the capſules are fleſhy, connate, and ventricoſe.

The ſpecies are four, the ſaponaria, ſpinoſus, trifoliatus, and chinenſis. The ſaponaria, with winged leaves, grows naturally in the iſlands of the Weſt Indies, where it riſes with a woody ſtalk from 20 to 30 feet high, ſending out many branches garniſhed with winged leaves compoſed of ſeveral pair of ſpear-ſhaped lobes. The midrib has a membranaceous or leafy border, running on each ſide from one pair of lobes to the other, which is broadeſt in the middle between the lobes; the flowers are produced in looſe ſpikes at the end of the branches; they are ſmall and white, ſo make no great appearance. Theſe are ſucceeded by oval berries as large as middling cherries, ſometimes ſingle, at others, two, three, or four are joined together; theſe have a ſaponaceous ſkin or cover, which incloſes a very ſmooth roundiſh nut of the ſame form, of a ſhining black when ripe. The ſkin or pulp which ſurrounds the nuts is uſed in America to waſh linen; but it is very apt to burn and deſtroy it if often uſed, being of a very acrid nature.

Saponaria ‖ Sapphira.

Theſe plants are propagated by ſeeds; they muſt be put into ſmall pots, and plunged into a hot-bed of tanners bark. In five or ſix weeks the plants will appear, when the glaſſes of the hot-bed ſhould be raiſed every day in warm weather, to admit freſh air to the plants. In three weeks or a month after the plants appear, they will be fit to be tranſplanted, when they muſt be ſhaken out of the pots, and carefully parted, ſo as not to injure their roots, and each planted into a ſeparate ſmall pot, and plunged into the hot-bed again, obſerving to ſhade them from the ſun until they have taken new root; after which time they muſt have free air admitted to them every day when the weather is warm, and will require to be frequently watered.

SAPONARIA, SOPEWORT, in botany: A genus of the digynia order, belonging to the decandria claſs of plants; and in the natural method ranking under the 22d order, *Caryophylleæ*. The calyx is monophyllous and naked; there are five ungulated petals; the capſule is oblong and unilocular.

There are eight ſpecies, the officinalis, vaccaria, cretica, porrigens, illyrica, ocymoides, orientalis, and lutea. The officinalis, which is a Britiſh plant, has a creeping root, ſo that in a ſhort time it would fill a large ſpace of ground. The ſtalks are about two feet high, and of a purpliſh colour. The footſtalks of the flowers ariſe from the wings of the leaves oppoſite; they ſuſtain four, five, or more purple flowers each; which have generally two ſmall leaves placed under them. The ſtalk is alſo terminated by a looſe bunch of flowers growing in form of an umbel; they have each a large ſwelling cylindrical empalement, and five broad obtuſe petals, which ſpread open, of a purple colour. Theſe are ſucceeded by oval capſules, with one cell filled with ſmall ſeeds.—The decoction of this plant is uſed to cleanſe and ſcour woollen cloths: the poor people in ſome countries uſe it inſtead of ſoap for waſhing; from which uſe it had its name.

SAPOR, TASTE. See TASTE, and ANATOMY, n° 139.

SAPOTA, PLUM, in botany. See ACHRAS.

SAPPERS, are ſoldiers belonging to the royal artillery, whoſe buſineſs it is to work at the ſaps, for which they have an extraordinary pay. A brigade of ſappers generally conſiſts of eight men, divided equally into two parties; and whilſt one of theſe parties is advancing the ſap, the other is furniſhing the gabions, faſcines, and other neceſſary implements. They relieve each other alternately.

SAPPHIRA, was the wife of a rich merchant in Gueldres, and equally diſtinguiſhed for her beauty and her virtue. Rhinſauld, a German officer, and governor of the town of Gueldres, fell in love with her; and not being able to ſeduce her either by promiſes or preſents, he impriſoned her huſband, pretending that he kept up a traiterous correſpondence with the enemies of the ſtate. Sapphira yielded to the paſſion of the go-

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